



**HP64000  
Logic Development  
System**

**Model 64601A  
Timing Analysis  
Control Board**

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 **HEWLETT  
PACKARD**

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HEWLETT-PACKARD  
SERVICE MANUAL  
MODEL 64601A  
TIMING ANALYSIS CONTROL BOARD

REPAIR NUMBERS

This Manual applies directly to Models  
with Repair Numbers prefixed 2148A.

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LOGIC SYSTEMS DIVISION  
COLORADO SPRINGS, COLORADO, U.S.A.

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## SAFETY SUMMARY

**The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements.**

### GROUND THE INSTRUMENT.

To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The instrument is equipped with a three-conductor ac power cable. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adapter with the grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet. The power jack and mating plug of the power cable meet International Electrotechnical Commission (IEC) safety standards.

### DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE.

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

### KEEP AWAY FROM LIVE CIRCUITS.

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

### DO NOT SERVICE OR ADJUST ALONE.

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

### DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT.

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification of the instrument. Return the instrument to a Hewlett-Packard Sales and Service Office for service and repair to ensure that safety features are maintained.

### DANGEROUS PROCEDURE WARNINGS.

Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed.

#### WARNING

**Dangerous voltages, capable of causing death, are present in this instrument.  
Use extreme caution when handling, testing, and adjusting.**

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General Information - Model 64601A

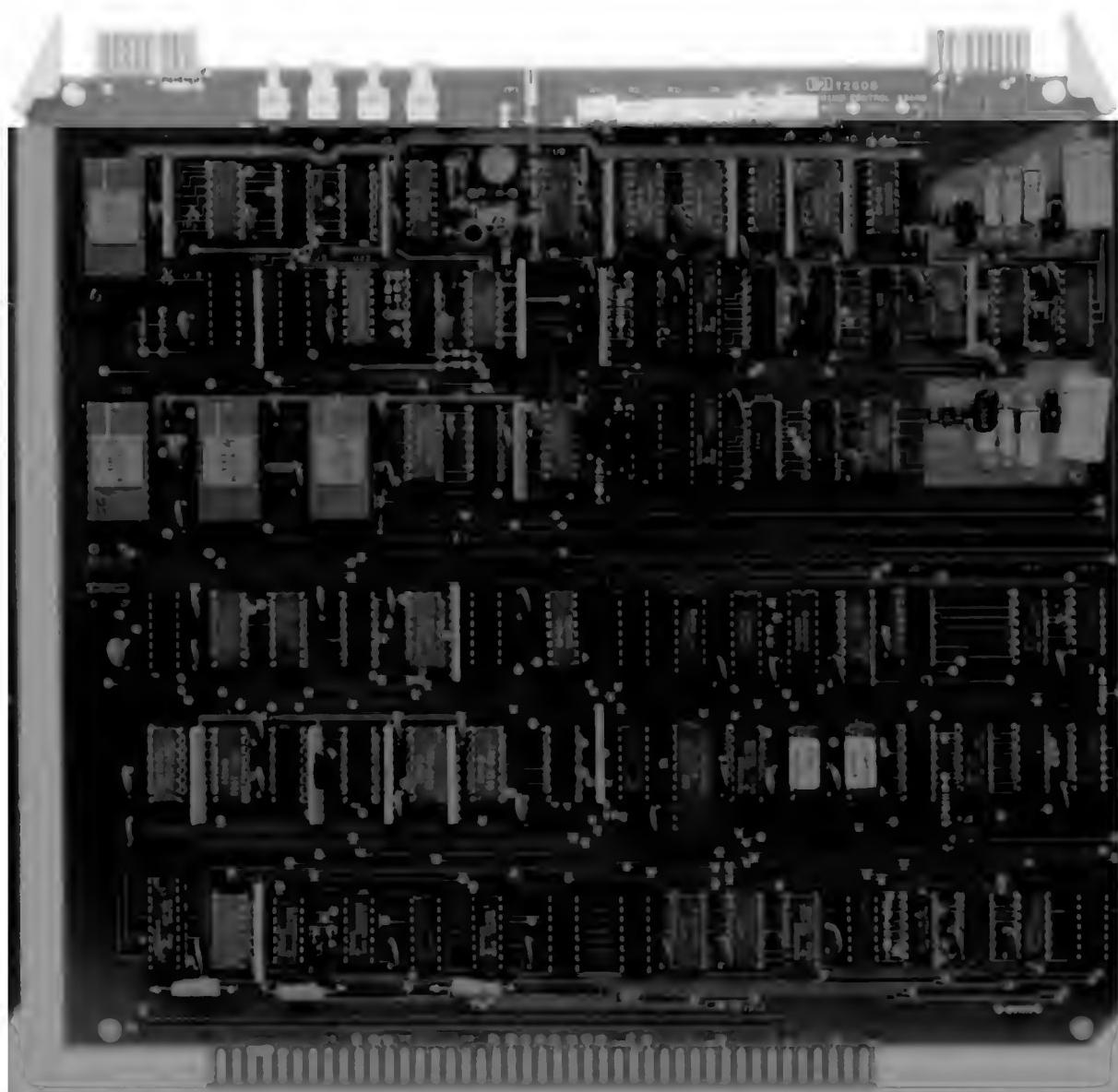


Figure 1-1. Model 64601A Timing Analysis Control Board

## SECTION I

### GENERAL INFORMATION

#### 1-1. INTRODUCTION.

1-2. This Service Manual contains information required to install, test and service the Hewlett-Packard Model 64601A Timing Analysis Control Board. Operating instructions are provided in a separate Operating Manual supplied with the instrument. It should be kept with the instrument for use by the operator.

1-3. Shown on the title page is a microfiche part number. This number can be used to order 4X6-inch microfilm transparencies of the manual. Each microfiche contains up to 96 photoduplicates of the manual pages.

#### 1-4. INSTRUMENTS COVERED BY THIS MANUAL.

1-5. Attached to the instrument or printed on the printed circuit board is the repair number. The repair number is in the form: 0000A0000. It is in two parts; the first four digits and the letter are the repair prefix, and the last five are the suffix. The prefix is the same for all identical instruments. The suffix, however, is assigned sequentially and is different for each instrument. The contents of this manual apply to instruments with the repair number prefix(es) listed under REPAIR NUMBERS on the title page.

1-6. An instrument manufactured after the printing of this manual may have a repair number prefix that is not listed on the title page. This unlisted repair number prefix indicates that the instrument is different from those described in this manual. The manual for this newer instrument is accompanied by a Manual Changes supplement. This supplement contains "change information" that explains how to adapt the manual for the newer instrument.

1-7. In addition to change information, the supplement contains information for correcting errors in the manual. To keep this manual as current as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement for this manual is identified with the manual print date and part number, both of which appear on the manual title page. Complimentary copies of the supplement are available from Hewlett-Packard.

1-8. For information concerning a repair number prefix that is not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard Office.

## **General Information - Model 64601A**

### **1-9. DESCRIPTION.**

**1-10.** The Timing Analyzer is used to monitor information flow in the time domain. The information may be a software program, the actions of a hardware state machine, or random logic signals.

**1-11.** The Timing Analyzer consists of one Model 64601A Timing Control Board, and from one to two Timing Data Acquisition Boards.

**1-12.** Up to two Acquisition Boards may be combined to form a Timing Analyzer with as many as 16 channels.

**1-13.** Logic Analyzers within one Mainframe may be connected together using the Inter Module Bus (IMB). One possible use of the IMB is to allow a State Analyzer to trigger a Timing Analyzer.

### **1-14. SPECIFICATIONS.**

**1-15.** Instrument specifications are listed in Table 1-1. These specifications are the performance standards or limits against which the instrument is tested.

**Table 1-1. Specifications.**

Includes Models 64601A Control Board, 64602A 8-Channel Acquisition, and 64604A 8-Channel Timing Probes.

**Sample rates**

Wide Sample Mode: variable from 2Hz to 200MHz.

Glitch mode: variable from 2Hz to 100MHz.

Dual Threshold: same as Wide Sample Mode.

Fast Sample: 400MHz.

**Memory length:**

Wide Sample, Glitch, & Dual Threshold Modes: 4060 samples.

400MHz Mode.....: 8140 samples.

**Memory width (8 channel system)**

Wide Sample.....: 8 channels.

Dual Threshold, Glitch, and 400MHz modes: 4 channels.

**Memory width (16 channel system--two acquisition boards)**

Double the width for a single, 8-channel system.

**Resolution:**

Total skew from probe tip:

Within pod: +/- 1.5ns.

Pod to pod: +/- 3.0ns.

Conditions: Input signal: VH = -1.0V, VL = -1.6V,  
VTH at -1.3V

Input slew rate > .25 V/ns

Sample rate accuracy: typically +/- .002%

**Probe characteristics**

Input Z: 100K ohms +/- 2%, shunted by <6pf.

**Drive requirements:**

Minimum input amplitude: 600mV P/P.

Minimum input overdrive: 200mV or 25% of input amplitude,  
whichever is greater.

Minimum input pulse width: 3.0ns at threshold.

Dynamic range: +/- 10V.

Maximum input: +/- 40V.

Threshold accuracy: +/- 50mV or +/- 2% whichever is greater.

Hysteresis: Typically 50mV.

**Glitch Mode**

Maximum sample rate: 100MHz.

Minimum width: 3.0ns at threshold.

Maximum width: sample period less 4.0ns.

## General Information - Model 64601A

### Specifications (continued)

#### Triggering

Time duration accuracy: +/- (20% + 2ns).  
Minimum width for narrower-than trigger: 6ns typical.  
Minimum width for transition trigger: 6ns typical.  
Displayed position accuracy: +/- 4 samples in Wide Sample, Dual  
Threshold, and Glitch Modes.  
: +/- 8 samples in Fast Sample Mode.

Delay from input to external BNC drive: Typically 60ns.

Delay from input to internal IMB drive: Typically 55ns.

Dead time for post-qualify measurement reset.

Typically 50ns + the time required to fill the memory  
with the selected amount of pre-trigger information.

Reset time for duration trigger: To meet the duration  
specifications, the trigger duty cycle must be no  
greater than 40%.

#### BNC Drive

Output signal swing in transition trigger mode:

Amplitude: 2.0V typical.

Width at 50%: 10ns typical.

Output signal swing in width greater-than trigger mode:

Amplitude: 2.5V typical.

Width: Input trigger width minus the selected duration.

Output signal swing in width less-than trigger mode:

Amplitude: same as in transition trigger mode.

Width: same as in transition trigger mode.

Position: occurs when trigger pattern disappears, before  
the selected duration times out.

#### IMB Functions (interconnection with other modules):

Master Enable (LE/ME)-----: drive, receive (Execute/Halt only)

Trigger Enable (LE/TE)-----: drive, receive.

Trigger (HE/TR)-----: drive, receive.

Delay Clock (HE/DCLK)-----: receive only.

Storage Enable (LE/SE)-----: not used.

SECTION II  
INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains information for installing and removing the Model 64601A. Included are initial inspection procedures, preparation for use, and instructions for repacking the instrument for shipment.

2-3. INITIAL INSPECTION

Installation - Model 64601A

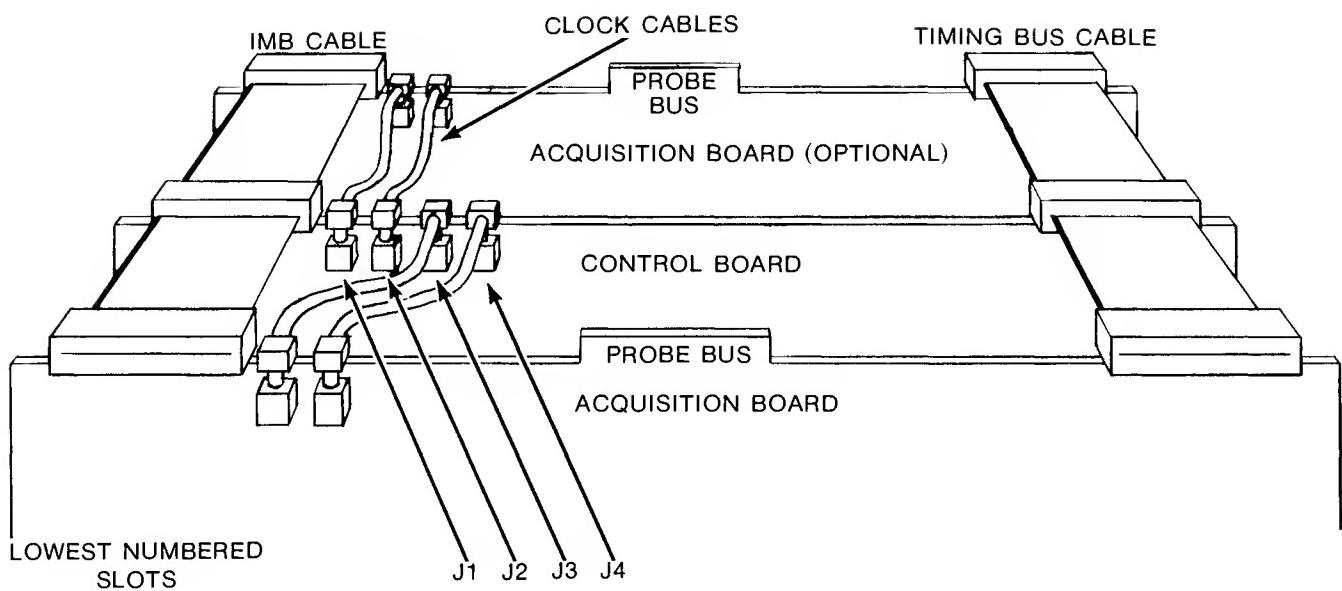


Figure 2-1. Timing Configuration

2-8. Mainframe Configuration.

2-9. Depending on the number of channels required, the timing analyzer will use two or three card slots of the mainframe cardcage.

2-10. One Timing Acquisition Board (64602A) should be installed in the lowest numbered card slot available. The Timing Control Board (64601A) then goes in the next higher slot. And if there is a second Acquisition Board, it will go in the next higher slot. In other words, Acquisition Boards are installed on either side of the Control Board. SEE FIGURE 2-1.

2-11. Up to two Acquisition Boards may be installed with one Control Board forming one Timing Analysis Subsystem.

2-12. Inter Module Bus (IMB).

2-13. Some systems may contain a combination of a timing analyzer and another type of analysis subsystem. The Inter Module Bus, located at the upper left-hand corner of the timing boards (when viewing from the component side) connects two or more analysis modules together for controlling and arming purposes. For example, a Timing Analyzer may arm a State Analyzer, and vice versa.

2-14. The IMB ribbon cable (W3 on the 64601A parts list) is connected the 64601A control board. Although 64602A acquisition boards have an inter module bus jack, there is no electrical connection between this IMB jack and the rest of the board. The 64602A communicates with the IMB through the 64601A control board. Since there is no electrical connection to the 64602A IMB jack and the rest of the board, this jack may have a ribbon cable connected to it for mechanical support.

2-15. Probe Bus

2-16. The timing analyzer communicates with the system under test by means of the 64604A Timing Probe. The probe cable (W2 on the 64602A parts list) connects to the probe bus located on the top center of the 64602A acquisition board.

2-17. Clock Cables.

2-18. The 64601A control board will supply four sample clock signals to two acquisition boards via SMC jacks J1, J2, J3, and J4 located on the top left-hand part of the board (when viewed from the component side).

2-19. Each 64602A acquisition board requires two clock inputs from the control board. Sample clocks are supplied from the control board to SMC jacks J1 and J2 on the top left-hand part of the acquisition board.

2-20. Clocks should be paired: The left-hand two jacks, J1 and J2, on the control board should be connected to one acquisition board; the right-hand two jacks, J3 and J4 should be connected to a second acquisition board.

## Installation - Model 64601A

### 2-21. Timing Bus.

2-22. The timing bus is at the top right-hand corner of the 64602A and 64601A timing boards (when viewing from the component side). The timing bus connects the timing Control Board to one or two Acquisition Boards.

2-23. The timing Control and Acquisition Boards must be grouped together to allow the timing bus ribbon cable (W1 on the 64601A parts list) to connect the Control Board to the Acquisition Board. When there are two Acquisition boards, which are placed on either side of the Control Board, a 3-position ribbon cable (W2 on the 64601A parts list) is used. Use only the timing bus cable with the part number given in the 64601A Control Board parts list. The three-position cable (64600-61603) is a special "split" cable which has lines 1-12 cut. See FIGURE 2-2.

- 4 - XE/TRIG from Acq.
- 5 - XE/TRIG from Acq.
- 11 - H/MEMFUL from Acq.
- 12 - H/MEMFUL from Acq.
- 15 - HE/RESET from Contr.
- 19 - H/RUN from Contr.
- 20 - L/PVC from Contr.

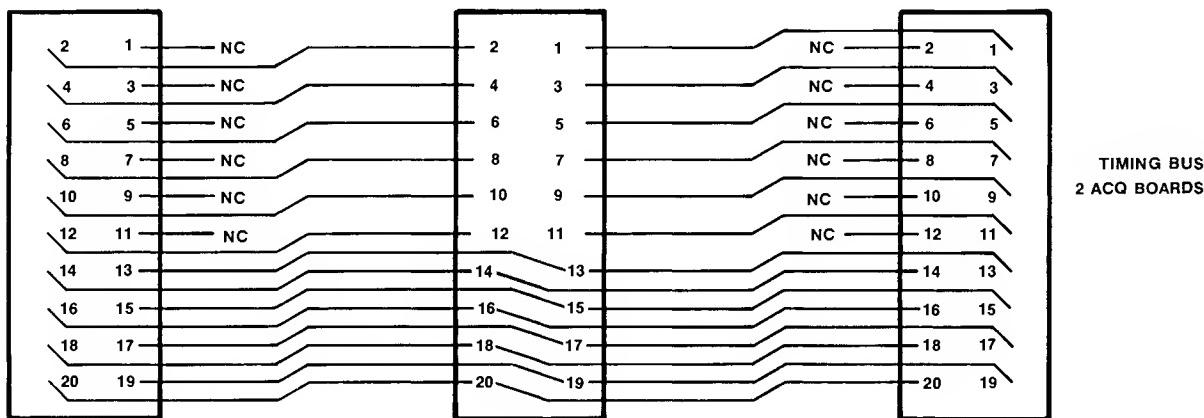
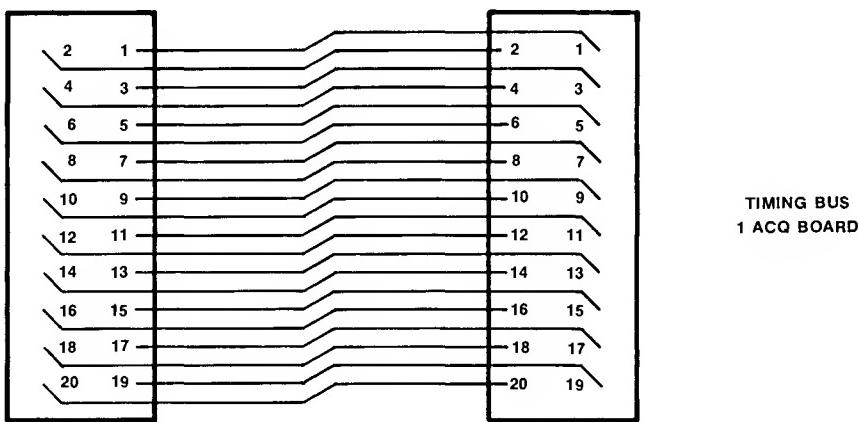


Figure 2-2. Timing Bus Cables

2-24. OPERATING, STORAGE, AND SHIPMENT ENVIRONMENTS.

CAUTION

THE GLITCH (U27) AND ENCODER (U22-25) CHIPS ON THE 64602A ACQUISITION BOARD ARE VERY SENSITIVE TO STATIC. THEY SHOULD BE LEFT IN CONDUCTIVE FOAM UNTIL INSTALLATION. GROUNDING STRAPS AND A GROUNDED WORK STATION ARE RECOMMENDED WHEN HANDLING THE ICS.

2-25. Operating Environment.

2-26. The Model 64601A may be operated in environments within the limits shown below. It should be protected from temperature extremes which cause condensation within the instrument.

Temperature.....	+10° to +40° degrees Celsius
Humidity.....	5% to 80% relative humidity
Altitude.....	4 600 m (15 000 ft)

2-27. Storage Environment.

2-28. The Model 64601A may be stored or shipped in environments within the following limits:

Temperature.....	-40° to +70° degrees Celsius
Humidity.....	5% to 80% relative humidity
Altitude.....	15 000 m (50 000 ft)

2-29. Packing.

2-30. Tagging for Service. If the instrument is to be shipped to a Hewlett-Packard Sales/Service Office for service or repair, attach a tag showing owner (with address), complete instrument repair number, and a description of the service required.

2-31. Original Packing. Containers and materials identical to those used in factory packing are available through Hewlett-Packard Offices. Mark the container FRAGILE to ensure careful handling. In any correspondence, refer to the instrument by model number and complete repair number.

## **Installation - Model 64601A**

**2-32. Other Packing.** The following general instructions should be used for repacking with commercially available materials:

- a. Wrap instrument in heavy plastic or paper. (If shipping to Hewlett-Packard Office or Service Center, attach a tag indicating type of service required, return address, model number, and complete repair number.)
- b. Use a strong shipping container. A double wall carton made of 350 pound test material is adequate.
- c. Use a layer of shock-absorbing material 70 to 100 mm (3 to 4 inches) thick around all sides of the instrument to provide firm cushioning and prevent movement inside container.
- d. Seal shipping container securely.
- e. Mark shipping container FRAGILE to ensure careful handling.
- f. In any correspondence, refer to instrument by model number and complete repair number.

SECTION III

OPERATION

The operation of the Model 64601A is a function of the system software. Complete system keyboard operation is beyond the scope of the service manual. Please refer to the operator's manual (64601-90903) for the procedure.

**Operation - Model 64601A**

**NOTES**

**SECTION IV**  
**PERFORMANCE TESTS**

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## 4-2. INTRODUCTION.

4-3. Performance verification tests check the major circuit blocks for proper operation, giving the operator at least 90% confidence that the board is operating correctly.

4-4. There are 15 PV Tests and 3 Supplementary Tests. The supplementary tests use different access instructions. They are described after the the regular 15 PV tests.

4-5. Signature analysis instructions and tables are given at the end of the section.

4-6. The performance verification tests are also used in troubleshooting: (1) They help to isolate troubles to particular blocks, and within particular blocks; (2) Each test corresponds to a one signature loop when running signature analysis.

4-7. Each test is shown on the mainframe screen as a bracket group of 0's. The 0's correspond to steps in a particular test. When the board fails a test step, the "0" for that step becomes a "1".

4-8. TROUBLESHOOTING TECHNIQUES.

4-9. Although each of the PV tests checks a specific circuit block, signals from other blocks are used. A failure in one block can be caused by failures in blocks upstream. When failures occur on a given PV test, check the schematics in TABLE 4-1 below for each test.

Table 4-1. Performance Tests VS Schematic

NUMBER	TEST	CHECK ON SCHEMATIC
1	SERIAL PROGRAMMING	1, 2
2	RUN/HALT/RESET	1, 7
3	TRIGGER	4, 5, 6
4	DELAY COUNTER AND TRIGGER POSITION	7
5	WINDOW	7
6	RATES/INTERVAL (B)	5
7	LESS THAN INTERVAL (B)	5
8	TRANSITION TRIGGER (B)	5
9	DISPLAY DRIVER	8, 9
10	RATES/INTERVAL (A)	4
11	LESS THAN INTERVAL (A)	4
12	TRANSITION TRIGGER (A)	4
13	AND	4, 5, 6
14	OR	4, 5, 6
15	B FOLLOWED BY A	4, 5, 6

4-10. Check board seating.

4-11. Check cable connections.

All cables should be fastened securely. The clock cables should be paired on the left or right two jacks. The timing bus and IMB cables should have the pin 1 wire connected to pin 1 on the jack. No cables other than the two listed in the 64601A Control Board manual parts list may be used for the timing bus.

4-12. Check supply voltages.

Supply voltages from the mainframe (+5V, -5.2V) should be within 5%. The -3.25V should be within 3%.

4-13. Isolate the problem to one board.

When a PV failure occurs, isolate the problem to either an acquisition board, or the control board. Check signatures on the timing bus, which connects the control board to the acquisition board(s). Look first at the signals HE/RUN and HE/RESET from the control board. If these are good, look at the return signals from the acquisition board(s), H/MEMFUL, XE/TRIG1(2). In a two-acquisition board system, H/MEMFUL comes from the acquisition board in the lower numbered slot only.

4-14. Check the programming.

In PV tests the mainframe stimulates the timing analyzer and verifies correct operation by looking at the status registers. Read each test description to see what is being stimulated. Look at the signatures on the outputs of address decoders, data latches, and mode registers where the mainframe is stimulating that PV test circuit block. Correct signatures may be traced back to where signals become incorrect.

4-15. Check the status registers.

A PV failure means the status registers for the control board on service sheet 1 will have one or more incorrect output signatures. The signal path may then be traced back to the problem.

4-16. PHYSICAL SETUP CONDITIONS FOR THE PV TESTS.

4-17. Conditions for the following tests:

- a. Connect the timing pod to the 64602A acquisition board by means of timing cable 64604-61601.
- b. Leave the probe leads disconnected, so that the probe inputs are floating near ground.
- c. Make sure the two clock cables are securely connected. Clock cables should be connected in pairs to either the two right or two left jacks.
- d. The timing bus cable should be connected to the jacks at the upper right-hand corner (when viewing from the component side) of both the 64601A control board and the one or two 64602A acquisition board(s). Only timing bus cables (two or three position) listed in the 64601A parts list should be used.
- e. NOTE: In noisy environments, ground each probe input, using the ground lead for each probe. Failure to do this may result in the PV displaying intermittent non-existent failures.

## Performance Tests and Troubleshooting - Model 64601A

4-18. KEYBOARD SETUP ( For running all 15 PV tests repeatedly ).

4-19. To verify that the entire board is operating correctly, perform the following steps on the mainframe keyboard: (FIGURE 4-1)

- a. With the operating system initialized and awaiting a command, press the softkey labeled "opt\_test" (you may have to keep pressing the "etc" softkey until you see "opt\_test" on the screen). Or you may type "option\_test" in lower case.
- b. Press [RETURN]. You should see a listing of all the optional boards that are present in your mainframe, along with their slot numbers.
- c. Type in the 64601A timing control board slot number. [RETURN]
- d. Press softkey "run".
- e. Press softkey "slot".
- f. Type in the 64601A timing control board slot number.
- g. Press softkey "repeated".
- h. Press [RETURN]. As shown in Figure 4-1, the screen will now show all 15 Control Board PV tests. Tests that pass will be indicated by "0", and failures will be indicated by "1". The screen will also show the number of times the tests are run, and the number of failures.

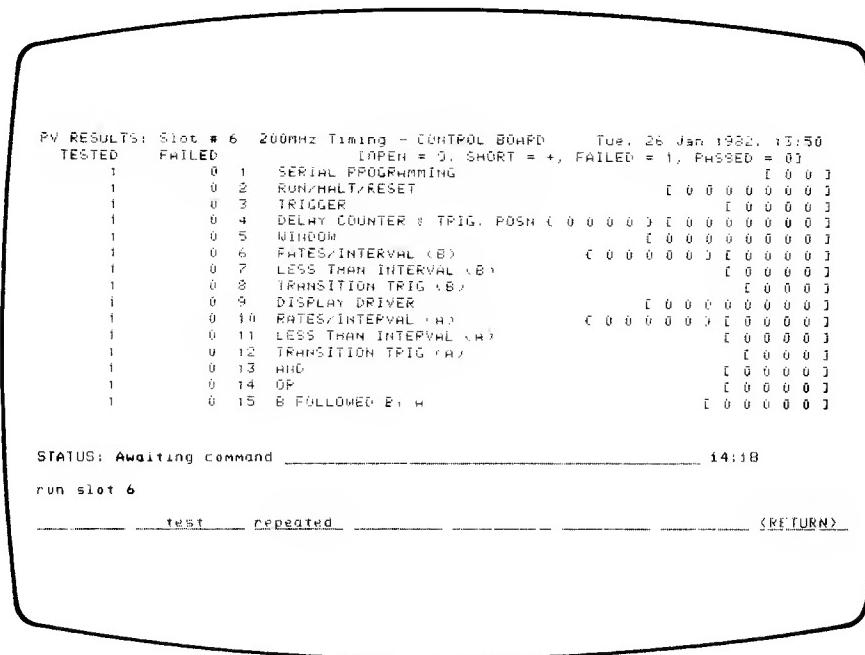


Figure 4-1. PV Test Display (16-channel system).

4-20. KEYBOARD SETUP ( For running one PV test repeatedly ).

4-21. To run one test at a time repeatedly for signature analysis, perform the following steps: (Figures 4-2 TO 4-10)

- a. Press softkey "opt\_test". [RETURN]
- b. Type in the 64601A timing control board slot number. [RETURN]
- c. Press softkey "run".
- d. Press softkey "slot".
- e. Type in the 64601A timing control board slot number.
- f. Press softkey "test".
- g. Type in the number of the test you wish to run.
- h. Press the soft key "repeated". [RETURN]

4-22. EXPLANATION OF THE TEST DESCRIPTIONS.

4-23. There are 15 (9 in an 8-channel system) performance verification tests for the timing control board. Each of these tests has one or more test steps, denoted by the 0's or 1's within brackets. A "0" in the bracket indicates a PASS for that test step; and a "1" indicates FAIL.

1. SERIAL PROGRAMMING	[00]
2. RUN/HALT/RESET	[0000000]
3. TRIGGER	[0000]
4. DELAY COUNTER & TRIG. POSN.	{0000}[0000000]
5. WINDOW	[00000000]
6. RATES/INTERVAL (B)	{00000}[0000]
7. LESS THAN INTERVAL (B)	[0000]
8. TRANSITION TRIGGER (B)	[000]
9. DISPLAY DRIVER	[00000000]
10. RATES/INTERVAL (A)	{00000}[0000] *
11. LESS THAN INTERVAL (A)	[0000] *
12. TRANSITION TRIGGER (A)	[000] *
13. AND	[0000] *
14. OR	[0000] *
15. B FOLLOWED BY A	[00000] *

\* Not used in an 8-channel, single acquisition-board system.

4-24. The numbered test steps described in each PV test correspond, from left to right, to the 0's or 1's within the displayed brackets.

4-25. The numbered test steps describe the commands given by the system software. They do not call for operator intervention.

---

4-26. TEST 1: SERIAL PROGRAMMING

[ 0 0 ]

test steps: 1 2

---

4-27. Purpose.

This test verifies the programming of the 130-bit control register, consisting of U1, U10, U11, U15, U36, U37, U38, U71, and U73. The 130-bit register is the means for programming the timing analyzer.

4-28. Test Steps. (Description of software execution)

1. The 130-bit shift register is loaded with all HIGHs, and a single LOW is walked through. There should be one LOW, and 129 HIGHs coming out the end of the shift register. The last bit, HE/STOP (U36-4), should be LOW.
2. Perform the above test using 129 LOWs and a single HIGH.

---

4-29. TEST 2: RUN/HALT/RESET

[ 0 0 0 0 0 0 0 ]

test steps: 1 2 3 4 5 6 7

---

## 4-30. Purpose.

This test verifies that the L/RUN bit at U90-6 can be exercised. The L/RUN bit stops the sample clock and disables the 64602A acquisition board memory address counters when it is high.

The test also verifies that the delay counter (U37), the window counter (U38), the trigger position counter (U51,U52), and the acquisition board memory address counters can be reset to 0.

4-31. Test Steps. (description of software execution)

1. HE/RESET is set high; and the H/HALT bit at U90-6 is set high.
  2. The H/HALT bit at U90-6 is set low.
  3. The U85 status bits, H/STOP, H/TRIG+DLY, H/MEMFUL, H/TC0, H/TC1, and H/TC2 should all be low.
  4. Prior to reset, the acquisition-board RAM counters were programmed to FFFFH; the counters should not be 0000H before reset.
  5. The RAM counters should be 0000H after reset.
- 6,7. If there is a second acquisition board, these steps are the same as 4 and 5 above for the second board.

---

4-32. TEST 3: TRIGGER

[ 0 0 0 0 ]

test steps: 1 2 3 4

---

4-33. Purpose.

This test checks the trigger path from the timing bus through the delay counter (U37).

4-34. Conditions set up by the software.

- a. The trigger enable counter (U38), the window counter (U36), and the delay counter (U37) are set for zero delay.
- b. HE/AND, HE/ATRANSIT, and HE/BTRANSIT are set HIGH, or true.
- c. LE/PDUR>A, LE/PDUR>B, LE/ENTRIGA, and LE/ENTRIGB are set HIGH, or false.
- d. Pattern duration is set greater than 5ns.

4-35. Test Steps. (Description of software execution)

The first step checks the trigger path from the term selector (U55) through the delay counter.

1. The 130-bit shift register is programmed for HE/PATT high at U55-2. H/TRIG+DLY at the status register (U85-4) should be high.

In the following three steps the trigger path is checked from the trigger selectors (U13 and U17) through the delay counter.

2. The 130-bit shift register is re-programmed so the analyzer itself will generate a trigger when HE/RESET is low. HE/RESET is set high: H/TRIG+DLY should be low.
3. XE/PVTRIG is programmed high true to the trigger selectors, U13 and U17. H/TRIG+DLY should be high at the status register (U85-4).
4. The trigger from each acquisition board can be programmed high true or low true. If XE/TRIG1, from the acquisition board in the lower numbered slot, is high--whether true or false--step 2 above may fail. Step 4 passes when XE/TRIG1 is low.

4-36. TEST 4: DELAY COUNTER & TRIG. POSN.

{ 0 0 0 0 } [ 0 0 0 0 0 0 0 ]

test steps: 1 2 3 4      5 6 7 8 9 10 11

## 4-37. Purpose.

This test checks the delay counter (U37), and the position counter (U51,U52). The tests in braces compare the delay counter against a software timer: The delay counter must "time out" within a 200us window in order to pass. If the tests in braces fail it may mean that the 25MHz system clock in the mainframe, or the 200MHz timing clock, are significantly off in frequency.

4-38. Conditions set up by the software. For this test, the window counter (U36) and the trigger enable counter (U38) are set to zero.

4-39. Test Steps. (Description of software execution)

1. The delay counter is loaded with a 1010... pattern, resulting in a delay of 167.8ms. H/TRIG+DLY should be false at 167.7ms.
2. H/TRIG+DLY should go true sometime during the 200us interval, between 167.7ms and 167.9ms.
3. The delay counter is loaded with a 0101... pattern, resulting in a delay of 55.8ms. H/TRIG+DLY should be false at 55.7ms.
4. A trigger should occur by the end of the 200us interval, before 55.9ms.

In the following bracket steps, the delay counter is checked against the memory address counters on the acquisition board. When the delay counter times out, it starts the window counter, which determines the "window" in memory between tracepoint (H/TRIG+DLY) and the end of acquisition. Since the window counter has been set to zero for this test, it immediately stops (H/STOP) the RAM counters when the delay counter times out.

5. In steps #1 and #2 above, when H/TRIG+DLY goes true during the 200us interval, it starts the window counter. Since the window counter has been set to zero, H/STOP immediately goes true, stopping acquisition and leaving the RAM counters with a certain count. This count is verified.
6. This is similar to step 5: The RAM counters should be correct at the end of the second 200us interval in steps 3 and 4 above.

DELAY COUNTER (continued)

Because the RAM counters have a capacity of only 256, the above steps could pass when the delay counter is actually off by a multiple of 256. To avoid that possibility, the mainframe processor clock is used to clock the delay, window, and position counters.

Since the processor clock is so much slower than the 200MHz timing analyzer sample clock, only the lower 16 bits of the delay counter are loaded with a pattern.

The signature analyzer is gated ON during the following test steps only.

7. The upper 8 bits of the delay counter are loaded with all 0's, and the lower 16 bits with 5555H. H/TRIG+DLY at the status register (U85-4) should be false one count before the delay counter is supposed to count out.
8. H/TRIG+DLY should be true on the next count.
9. The upper 8 bits of the delay counter are loaded with all 0's, and the lower 16 bits with 2AAAH. H/TRIG+DLY should be false one count before overflow.
10. The trigger should be true on the next count.
11. This step checks the 3-bit trigger position counter. At the end of step 4, H/TC0 should have been HIGH. Then, during step 7, H/TC1 and H/TC2 go HIGH at different times; and finally, all three, H/TC0, H/TC1, and H/TC3, finish in a LOW state at the end of step 7.

4-40. TEST 5: WINDOW COUNTER

[ 0 0 0 0 0 0 0 0 ]

4-45. TEST 6: RATES/INTERVAL (B)

{ 0 0 0 0 0 } [ 0 0 0 0 ]

test steps: 1 2 3 4 5 6 7 8 9

4-46. Purpose.

A user of the timing analyzer may specify pattern durations: a trigger will then occur only when the pattern lasts a given length of time.

In this test a trigger must not occur when the pattern lasts less than the given time. The user may thus ensure that triggering does not occur on transients or shorter patterns.

This test checks the B term generator duration circuits (U44,U46,U47) and the sample rate clock. For a given sample rate, the acquisition board memory address counters are used to verify the accuracy of the selected interval within 20%.

The tests in braces check each capacitor and current source at a different sample rate.

With ranges <1us, the resolution is not good enough to verify the specs.

4-47. Theory.

When tracepoint (H/TRIG+DLY) is generated, the window counter (U36) counts down to determine the amount of "window" between tracepoint in memory and the end of new acquisition. When the window counter times out, it generates H/STOP, stopping the sample clock and, consequently, the acquisition-board RAM counter.

By setting the window counter (U36), the delay counter (U37), and the trigger enable counter (U38) to zero, the only delay between the acquisition-board trigger (XE/TRIG) and H/STOP is that selected by the duration circuits in the term generators.

RATES/INTERVAL B (continued)

4-48. Test Steps. (Description of software execution)

The acquisition board memory address counters verify within 20% the accuracy of the duration circuits. After each test step, the counters are checked. For the duration circuits to pass, the counters must fall within the allowable range.

1. Duration circuits are set to 10us, sample rate is 50MHz.
2. Duration is set to 100us, sample rate is 200MHz.
3. Duration is set to 1us, sample rate is 100MHz.
4. Duration is set to 50us, sample rate is 40MHz.
5. Duration is set to 200us, sample rate is 10MHz.

The following steps in brackets use a single capacitor and different current sources. If these steps pass, and the previous ones fail, the problem is likely to be a capacitor or the particular sample rate circuitry associated with the step that fails.

6. Duration is set to 2us, sample rate is 200MHz.
7. Duration is set to 5us, sample rate is 200MHz.
8. Duration is set to 10us, sample rate is 200MHz.
9. The last test verifies that HTRIG+DLY was true, or HIGH, in all previous test steps.

---

4-49. TEST 7: LESS THAN INTERVAL (B)

[ 0 0 0 0 ]

test steps: 1 2 3 4

---

4-50. Purpose.

In this test the duration circuits must "time out" before the trigger pattern ends. If "timeout" occurs before the Acquisition Board trigger signal XE/TRIG disappears, the analyzer should trigger.

4-51. Theory.

The B term generator duration circuits ramp down from ground after receiving a LOW trigger signal from U35-14. The mainframe processor programs the time it takes to fire the schmitt circuit (U34).

4-52. Conditions.

- a. The acquisition board DACs are set for an "always trigger" condition lasting a specified time.
- b. The delay counter (U37) and the trigger enable counter (U38) are set to zero.
- c. LE/PDUR>B is programmed true, or LOW; and HE/BTRANSIT false, or LOW. (In other words, we specify level triggering and require the duration circuits to time out while the pattern is still true).

4-53. Test Steps. (Description of software execution)

1. H/TRIG+DLY is initialized false, or LOW.
2. The duration circuits are programmed for a 200us duration. The DAC thresholds are set to cause an "always trigger" for longer than 200us. H/TRIG+DLY should be true at the status register (U85-4).
3. H/TRIG+DLY is initialized false.
4. With the duration circuits still set for 200us, the DACs are programmed to cause an acquisition board trigger signal lasting less than 200us. H/TRIG+DLY should be false.

4-54. TEST 8: TRANSITION TRIGGER (B)

[ 0 0 0 ]

test steps: 1 2 3

## 4-55. Purpose.

This test checks the B term generator transition circuits (U42 and U43). Thresholds which simulate a particular pattern are programmed into the acquisition board DACs, and the glitch chip (U27 on the acquisition board) is programmed to trigger on that pattern.

## 4-56. Theory.

The B term generator transition circuit will cause a trigger on a transition away from, or leaving the specified pattern when HE/BTRANSIT is true and LE/PDUR>B is false.

Under the same conditions, the analyzer will trigger on a transition into, or entering the pattern when the acquisition board trigger XE/TRIG is low true. (The "X" in the mnemonic indicates this signal can be programmed either low true or high true).

## 4-57. Test Conditions.

- a. The delay counter (U37), trigger enable counter (U38), and window counter (U36) are set to zero.
- b. HE/BTRANSIT is high. We want to trigger on a transition.
- c. LE/PDUR>B is high. We are triggering on a transition, not an interval.
- d. XE/TRIG1 from the acq board is programmed low true for this test.

4-58. Test Steps. (Description of software execution)

1. During RESET, the transition circuits are programmed for transition triggering, the DAC thresholds are set up to simulate a pattern, and the glitch chip is programmed to recognize that pattern. During RUN, H/TRIG+DLY should be false because there has been no transition.
2. The pattern on the input is changed. This is a "leaving" transition. H/TRIG+DLY should remain false because XE/TRIG1 is low true.
3. Setting the thresholds back to their original value is, in effect, an "entering" transition. H/TRIG+DLY should go true.

---

4-59. TEST 9: DISPLAY DRIVER

[ 0 0 0 0 0 0 0 ]

test steps: 1 2 3 4 5 6 7 8

---

The Display RAMs are loaded with eight different patterns and read out. This tests the programming, the mode control circuits, the address latches, and the RAMs.

4-60. TEST 10: RATES/INTERVAL (A) (16 CH. ONLY)

---

{ 0 0 0 0 0 } [ 0 0 0 0 ]

test steps: 1 2 3 4 5      6 7 8 9

---

This is the same as TEST 6 above for the B term generator.

4-61. TEST 11: LESS THAN INTERVAL (A) (16 Ch. Only)

---

[ 0 0 0 0 ]

test steps: 1 2 3 4

---

This is the same as TEST 7 above for the B term generator.

4-62. TEST 12: TRANSITION TRIGGER (A) (16 Ch. Only)

---

[ 0 0 0 ]

test steps: 1 2 3

---

This is the same as TEST 8 for the B term generator.

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---

4-63. TEST 13: AND (16 Ch. Only)

[ 0 0 0 0 ]

test steps: 1 2 3 4

---

4-64. Purpose.

This test checks the AND/OR combination circuits (U13,U17,U34,U35). HE/AND is set high.

4-65. Theory.

In a 16-channel, two-acquisition board system, each acquisition board provides a trigger signal to the control board via the timing bus.

---

4-67. TEST 14: OR (16 Ch. Only)

[ 0 0 0 0 ]

test steps: 1 2 3 4

---

4-68. Purpose.

This is the same as the above test, except that H/EAND is false, or low.

4-69. Test Steps. (Description of software execution)

1. Low XE/TRIG1 and low XE/TRIG2. H/TRIG+DLY should be low at U85-4.
2. Low XE/TRIG1 and high XE/TRIG2. H/TRIG+DLY should be true, or high.
3. High XE/TRIG1 and low XE/TRIG2. H/TRIG+DLY should be high.
4. High XE/TRIG1 and high XE/TRIG2. H/TRIG+DLY should be high.

4-70. TEST 15: B FOLLOWED BY A (16 Ch. Only)

---

[ 0 0 0 0 0 ]

test steps: 1 2 3 4 5

---

4-71. Purpose.

This tests the programming, the term generators, the B latching circuit (U67,74), and the arming circuits (U54,55,69).

4-72. Theory.

The A and B term generators select and combine acquisition board triggers. Besides AND/OR combinations, there is a B-before-A combination. A signal satisfying the B term generator is latched, and the analyzer then waits for an A signal to occur before triggering.

LE/ENLATCHB into U55 must be low for the latched B mode.

4-73. Test Steps. (Description of software execution)

1. HE/TRIGA out of the A term generator is high, and HE/TRIGB is low. H/TRIG+DLY should be low at U85-4.
2. Both HE/TRIGA and HE/TRIGB are low. H/TRIG+DLY should be low.
3. HE/TRIGA is low and HE/TRIGB is high: The B latch is now set. H/TRIG+DLY should still be low.
4. Both HE/TRIGA and HE/TRIGB are low. H/TRIG+DLY should be low. The B latch should remain set because there has been no RESET.
5. HE/TRIGA is high and HE/TRIGB is low. We now have an A trigger occurring after a latched B trigger. H/TRIG+DLY should be high.

4-74. SUPPLEMENTARY DISPLAY TEST.

Further confirmation of proper display driver operation may be obtained visually by pressing the following softkeys in sequence: "run slot \_\_ display\_test". Press [RETURN] and the first pattern appears. This pattern verifies, by corner brackets, proper timing display centering. You may observe other test patterns by continuing to press [RETURN] until the first pattern finally reappears.

Fifteen unique patterns are illustrated in figures 4-2 to 4-16. The last 11 patterns (figures 4-5 to 4-16) are repeated eight times in the displays, and shifted by one dot in each display. The repetitions are not shown in the manual.

Except for the eight-dot shift in the patterns following those shown in figures 4-5 to 4-16, the screen patterns should look similar to the illustrations. Intensity alternations cannot be shown in the manual, but will be described.

Although the purpose of the patterns is primarily to generate signatures, defects in the displays may help to isolate problems. For example, address line shorts may put one character adjacent to another. An open line might take away a character that should be there. Or perhaps one character will be substituted for another, eg glitch for cursor. Look primarily for irregularities and discontinuities.

Examples of possible problems:

Irregularities.

Misshapen characters.

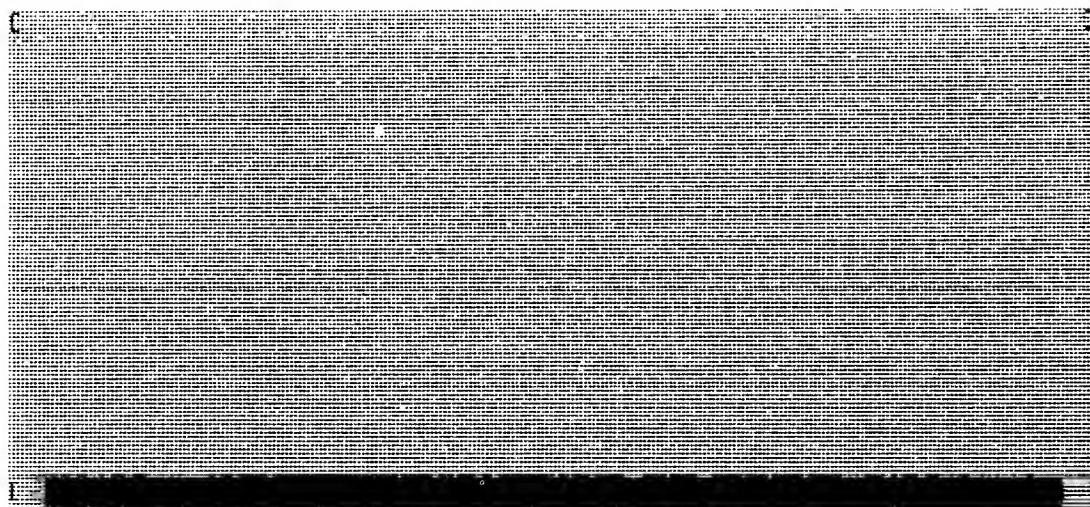
Glitch instead of normal data, or vice versa.

Adjacent line shorts may show up as adjacent graticules, cursors, etc.

Blanks instead of characters.

Highs instead of lows, or vice versa.

Transition characters substituted for other data characters, or vice versa.



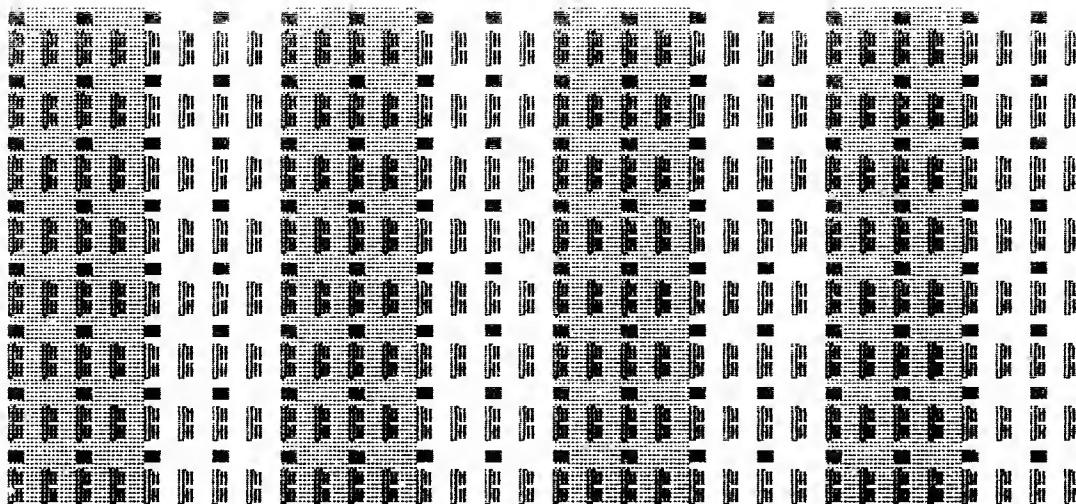
Press NEXT PAGE to CONTINUE

Figure 4-2.

This display checks the proper centering of the pattern.

The bar at the bottom and the brackets are generated by the mainframe. The timing analyzer display driver puts out the dot pattern, which should be centered within the brackets as shown.

Problems might be in the Start-Address Latches (U92, 93) or the Row, Char, or Line Counters (U78, 94-96).



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Figure 4-3.

This is an alternating pattern of high-low transitions, low-high transitions, glitches, graticule, and cursor. This is the first pattern for signature analysis.

Characters Exercised.

Data Characters.

High-low/low-high transition characters (Two every eight dots).

Enhancement Characters.

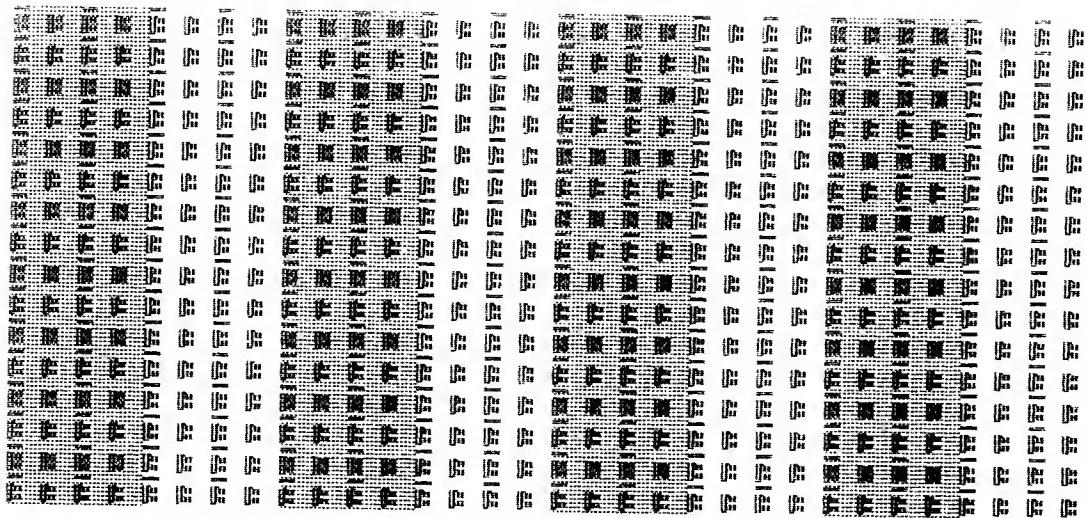
Intensity (alternating every 12 dots).

Graticule (on for 32 dots, then blanked for 32 dots).

Cursor (alternating, on for four dots, off for 12 dots)

Blanking (on for four dots, off for four dots during the time the graticule is off).

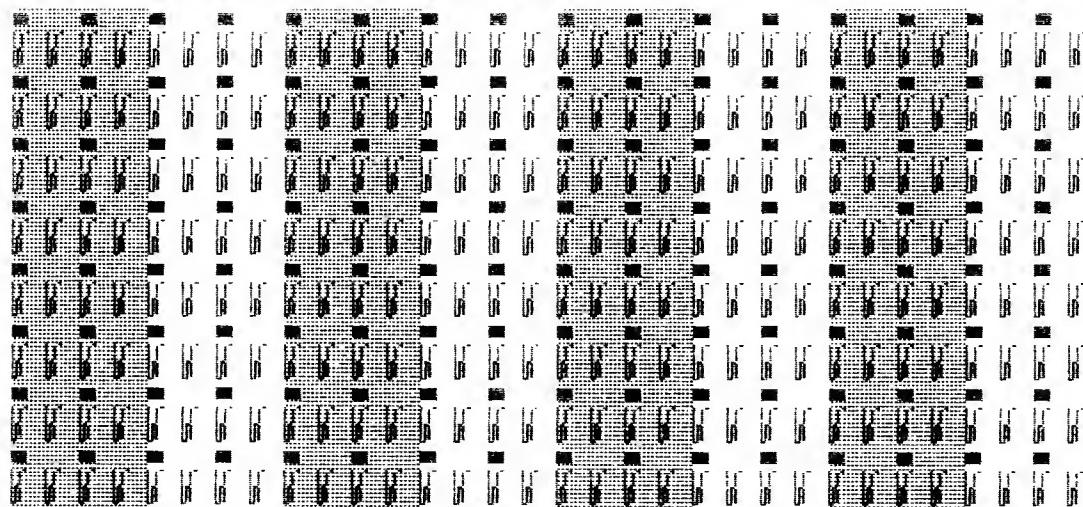
Glitches (Two every eight dots).



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Figure 4-4.

This is the same as the previous pattern, but for 16 channels. This is the second pattern for signature analysis.



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Figure 4-5.

This is the third pattern for signature analysis.

Characters Exercised.

Data Characters.

High (following every glitch character).

High-low transition (alternating every eight dots).

Enhancement Characters.

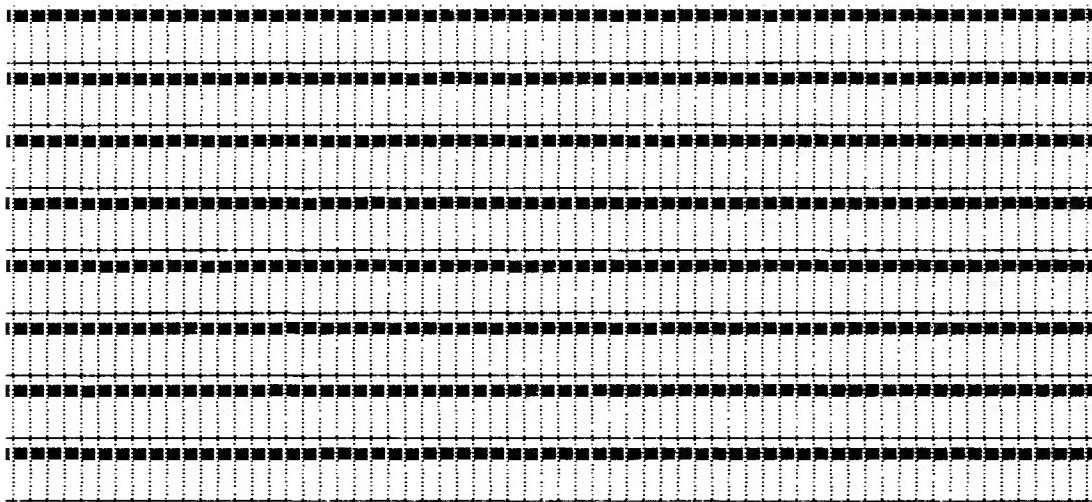
Cursor (alternating, on for four dots, off for 12 dots).

Graticule (alternating, continuous for 32 dots, then off for 32 dots).

Dual Threshold (following every high-low transition).

Glitch (following every dual threshold character).

Blanking (lasts for four dots on the part of the display where there is no cursor).



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Figure 4-6.

This display is repeated eight times and shifted by one dot.

Characters Exercised.

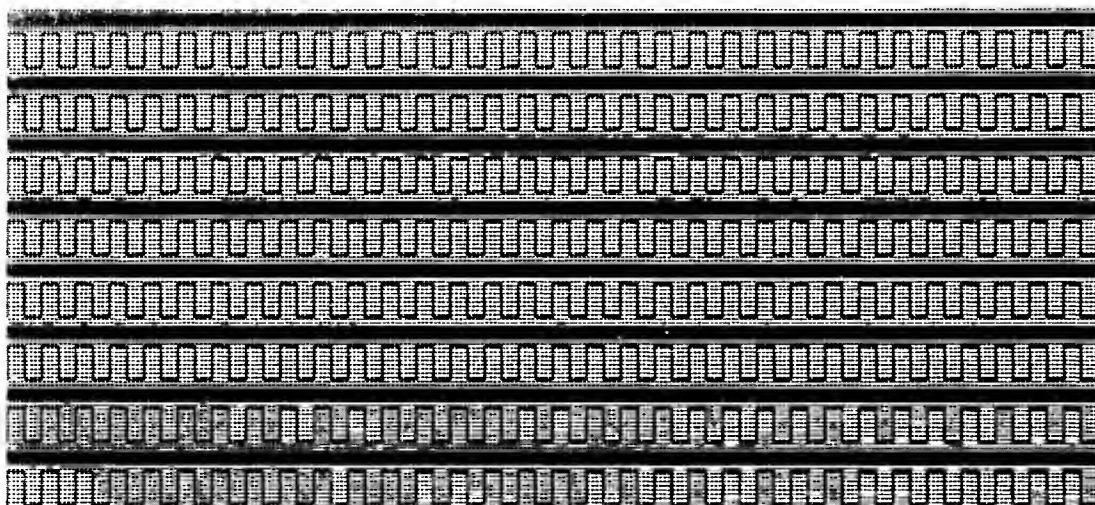
Data Characters.

Low (continuous on all channels).

Enhancement Characters.

Graticule (every fourth dot).

Cursor (continuous except for graticule columns).



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Figure 4-7.

This is a pattern of highs lasting four dots, high-low transitions, lows lasting four dots, and then low-high transitions. This display is shifted by one dot in each of the next eight displays (not shown).

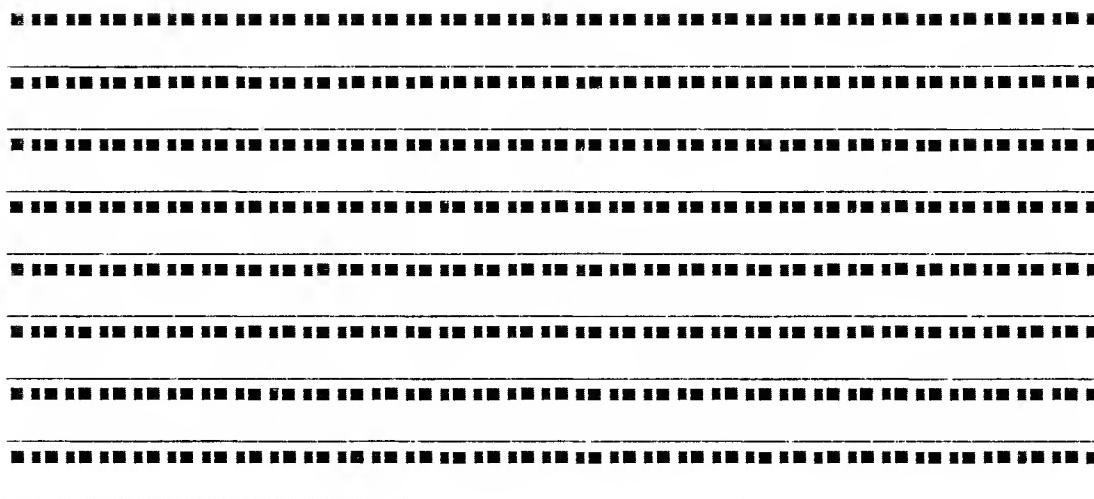
Characters Exercised.

Data Characters.

- High (Alternating every four dots).
- Low (Alternating every four dots).
- High-low transitions.
- Low-high transitions.

Enhancement Characters.

- Graticule (continuous).
- Cursor (continuous).
- Intensify (all).



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Figure 4-8.

This pattern is displayed eight times and shifted by one dot each time.

Characters Exercised.

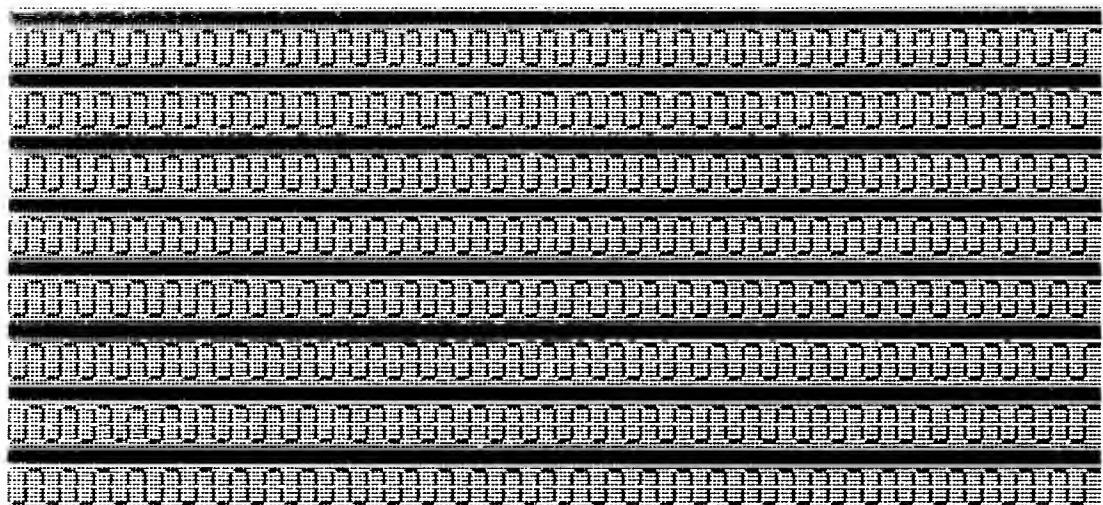
Data Characters.

Low (continuous on all channels).

Enhancement Characters.

Intensity (alternating pattern imposed on the continuous lows, shifted in each display).

Cursor (on for four dots, off for two, on for two, off for one, then repeating).



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Figure 4-9.

This is a pattern of four highs and a glitch, then four lows and a glitch. The pattern is shifted by one dot in each of the following eight displays.

Characters Exercised.

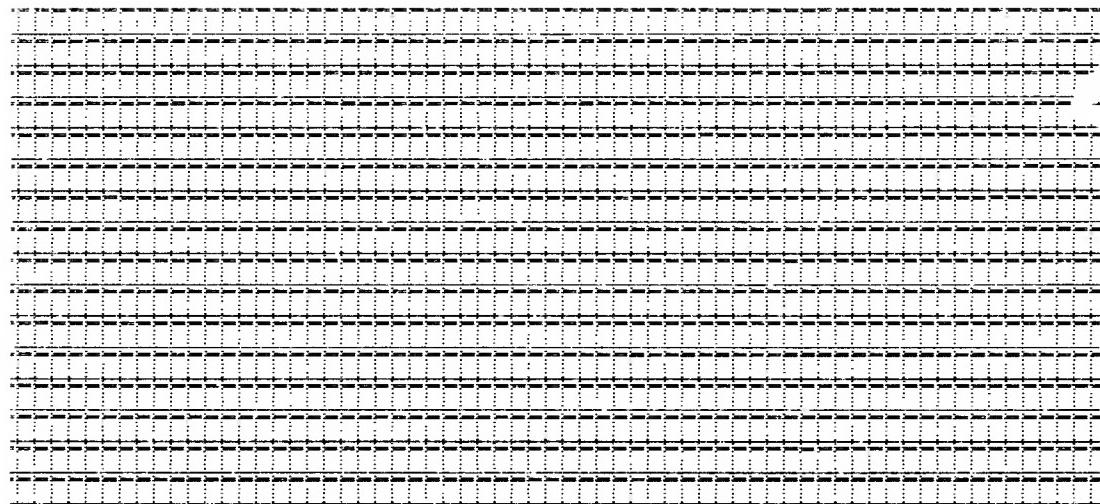
Data Characters.

High (lasting four dots, followed by a glitch, then four lows).  
Low (lasting four dots, followed by a glitch, then four highs).

Enhancement Characters.

Graticule (continuous).  
Cursor (continuous).  
Intensity (all).

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Figure 4-11.

This is the 16-channel version of figure 4-6, shifted by one dot in each of the next eight displays.

Characters Exercised.

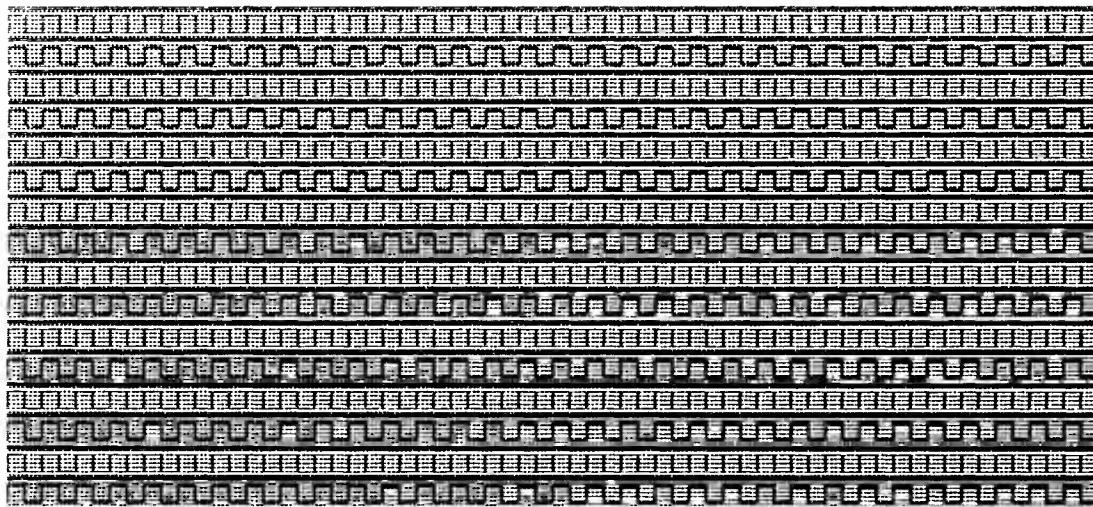
Data Characters.

Low (continuous on every channel).

Enhancement Characters.

Graticule (every fourth dot).

Cursor (alternates with the graticule).



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Figure 4-12.

This is the 16-channel version of figure 4-7, shifted by one dot in each of the next eight patterns. This is a shifting pattern of highs lasting four dots, high-low transitions, lows lasting four dots, and then low-high transitions.

Characters Exercised.

Data Characters.

High (lasting for four dots, and then alternating with four-dot lows).  
Low (lasting for four dots, and then alternating with four-dot highs).

Enhancement Characters.

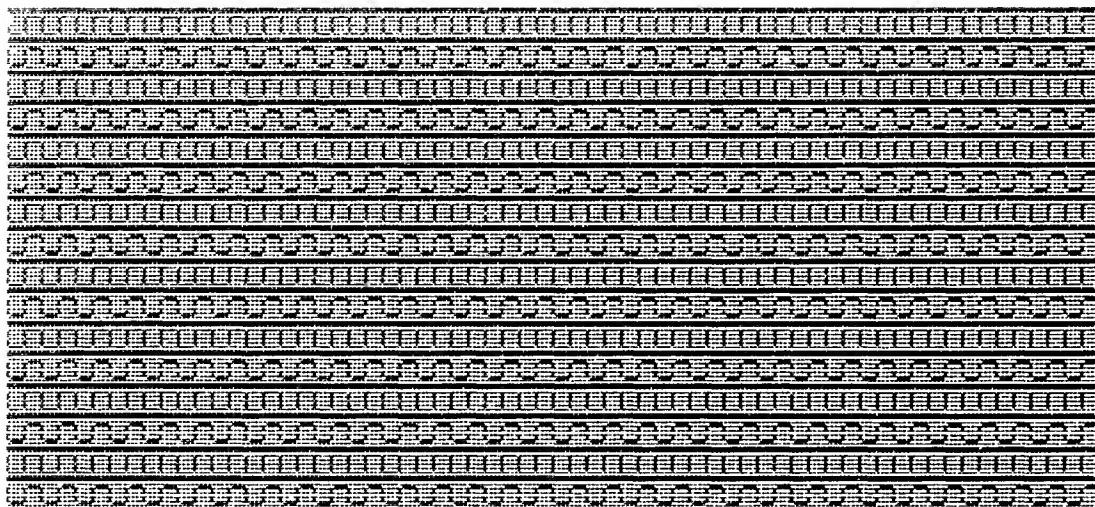
Graticules (continuous).  
Cursor (continuous).  
Intensify (continuous).



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Figure 4-13.

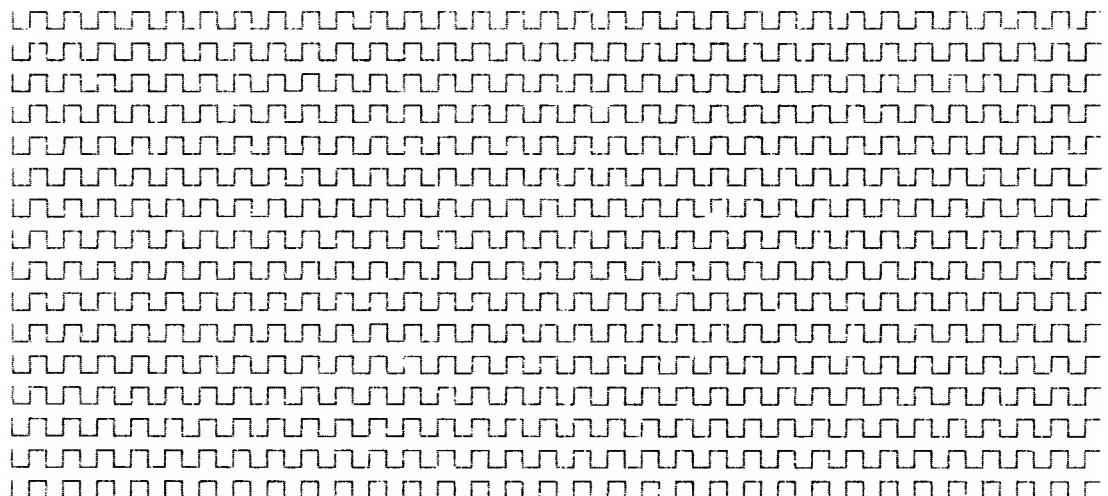
This is the 16 channel version of figure 4-8, shifted by one dot in each of the next eight displays.



Press NEXT PAGE to CONTINUE.

Figure 4-14.

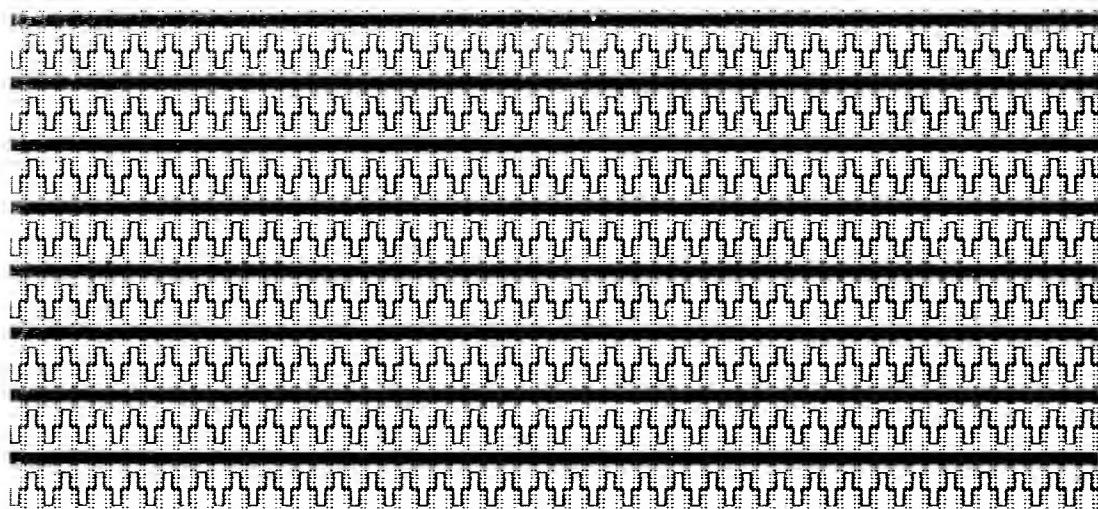
This is the 16-channel version of figure 4-9. The following eight displays are each shifted by one dot. The pattern consists of glitch characters every four dots, followed by highs for four dots, and then lows for four dots. Intensity, cursor, and graticule are continuous.



Press NEXT PAGE to CONTINUE

Figure 4-15.

This is the 16 channel version of figure 4-10. It is an alternating pattern of data characters: high, low, high-low transitions, and low-high transitions. The following eight patterns are each shifted by one dot. There are no enhancement characters.



Press NEXT PAGE to CONTINUE

Figure 4-16.

This is an alternating pattern of highs, small transitions, middles, and lows. The pattern is shifted by one dot in the following eight displays.

Characters Exercised.

Data Characters.

- High (alternate with dual threshold and low characters).
- Low (alternate with dual threshold and high characters).

Enhancement Characters.

Graticule (repeated twice, blanked twice, repeated twice, etc.).

Cursor (continuous).

Intensity (cursor is intensified every other two dots, and middles are intensified).

Dual Threshold (alternate with highs and lows).

4-75. INTER MODULE BUS PERFORMANCE VERIFICATION. (Supplementary PV test)

4-76. This is a supplementary PV test. To access this test press the following keys:

- a. Press "opt\_test"; RETURN
- b. Type the timing control board slot number; RETURN
- c. Press "test\_IMB"; RETURN
- d. The screen should show a display like Figure 4-3.

```
Inter Module Bus Performance Verification      Tue, 19 Oct 1982, 11:12
Slot #  ID #  Module description
----- -----
 3    1001   200 MHz Timing Analyzer      64601A TIME_CTL
Board for IMB stimulus
 7    1001   200 MHz Timing Analyzer      64601A TIME_CTL
IMB test results (1 = Error)
 RECEIVE 000000 (DCLK,LME,LTE,HTR,RST,HLD)  DRIVE  0000 (RNC4,LME,LTE,HTR)
IMB stimulus board limitations (1 = Not tested)
  DRIVE 100000 (DCLK,LME,LTE,HTR,LTE,HTR) RECEIVE 1000 (RNC4,LME,LTE,HTR)

TESTED      0     FAILED      0
```

Figure 4-17. Inter Module Bus Performance Verification.

4-77. For this test, there must be another analyzer, either state or timing, present in the mainframe. One analyzer is the "test" board and the other is the "stimulus" board.

4-78. The test checks each of the IMB lines that are used commonly by the stimulus and test boards. In figure 4-3, slot 3 contains the test board and slot 7 contains the stimulus board.

4-79. All the test board lines that can be driven or received are listed in the display under the heading "IMB test results". When six 0's, 000000, are indicated for RECEIVE, and four 0's are indicated for DRIVE, all IMB lines pass satisfactorily.

4-80. When the particular stimulus board used in the test is unable to drive or receive certain lines, those lines are indicated under the heading "IMB stimulus board limitations". A "1" indicates those lines which cannot be tested. In figure 4-3, for example, the stimulus board in slot 7 cannot drive the DELAY CLOCK line, and cannot receive from the BNC4 external connector. Without this limitation listing, those lines would normally show errors.

4-81. Description.

4-82. DCLK. (Same as HE/DCLK, GMC, PDC).

1. The stimulus board sends ten clocks over this line.
2. The test board must receive ten and only ten clocks.

4-83. LME, LTE, HTR. (Same as LE/ME, LE/TE, LE/TR)

1. These three lines are initialized low.
2. The stimulus board drives one line at a time high.
3. The test board must see a high only on the exercised line.
4. The three lines are initialized high.
5. The stimulus board drives one line at a time low.
6. The test board must see a low only on the exercised line.

4-84. RST, HLD (Same lines as LE/TE, HE/TR)

In the Post Qualify Mode, HTR and LTE have different functions than in the other timing analyzer modes. HTR is a HOLD command from another analyzer over the IMB, and LTE is the RESET command.

In the Post Qualify Mode, the timing analyzer triggers independently; then at some later time, another analyzer can initiate a re-run of the timing analyzer, or tell it to hold its present data.

The Post Qualify Mode, then, consists of three possible states: (1) The NORMAL data acquisition state, in which the timing analyzer is acquiring data while looking for a trigger condition. (2) The HOLD state, in which the timing analyzer has triggered and is told by a second analyzer to hold its data. (3) The RESET state, in which the timing analyzer is told by another analyzer to RESET and watch for another trigger condition.

4-85. POST-QUALIFY MODE -- RESET

1. DACs are set for an "always trigger" condition.
2. Stimulus board drives LTE true.
3. DACs are programmed for a "no trigger" condition.
4. LTE is set false. This should initiate a RESET. Since the DACs are set for "no trigger", the measurement should still be running (incomplete) because LTE did reset the analyzer and there was still no trigger.
5. DACs are set for an "always trigger" condition.
6. The analyzer should trigger and stop the measurement.

4-86. POST-QUALIFY MODE -- HOLD

1. DACs are set for "always trigger".
2. Test board drives HTR true.
3. Stimulus board drives LTE true.
4. DACs are set for "never trigger".
5. Stimulus board drives LTE false. There should still be a trigger because HTR (which is a HOLD line in the POSTQUALIFY mode) is still true. The HOLD prevents a RESTART.
6. The stimulus board now drives HTR true. The timing analyzer is still programmed for the POST-QUALIFY MODE, but it no longer drives HTR.
7. DACs are set for "never trigger".
8. Initiate a HOLD from the stimulus board by driving HTR true.
9. Set the DACs for "always trigger".
10. Verify that HOLD (HTR) prevents a trigger.

4-87. SUPPLEMENTARY BOARD ID TEST.

4-88. The board ID circuits have stable signatures when "opt\_test" is pressed. If the Timing Boards are not then listed on the screen, the ID circuitry is not working. Check the ID circuitry signatures at U88 and U99.

4-89. The following figures (4-18 to 4-26) show the operator softkey sequence needed to run a single PV test repeatedly for signature analysis purposes. Each PV test corresponds to one signature loop. Signature lists are given following the figures.

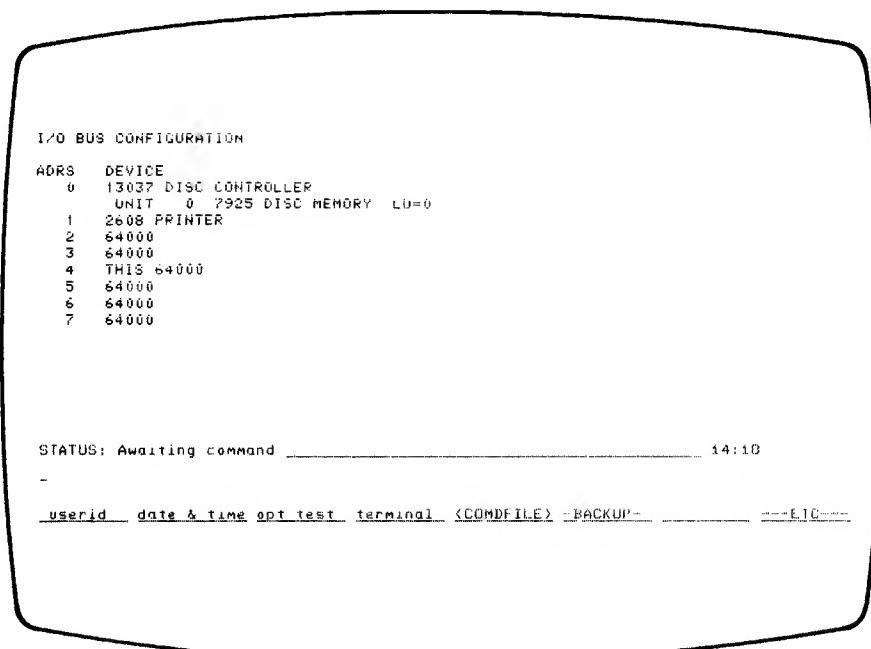


Figure 4-18. Press "opt\_test".

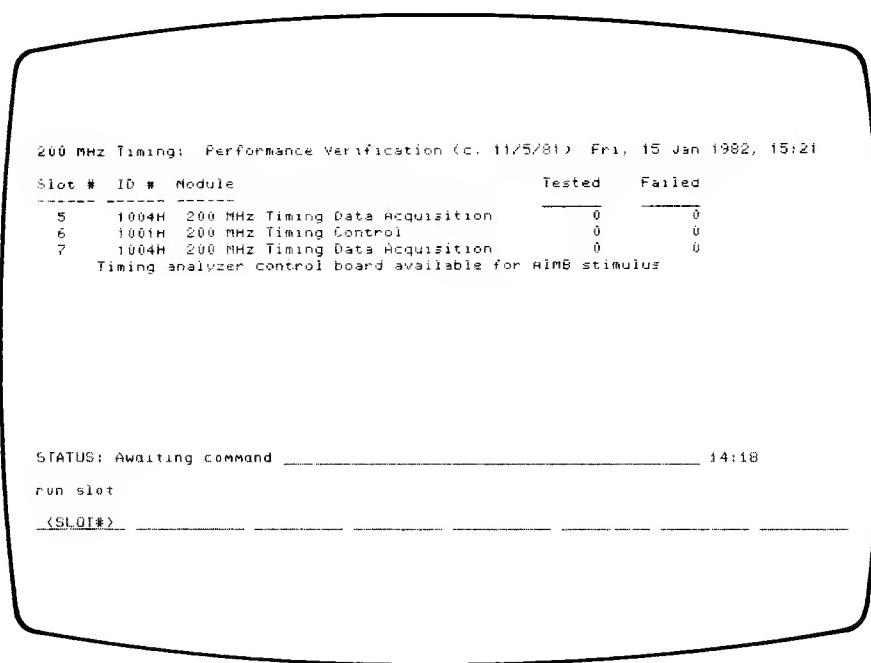


Figure 4-19. Type the slot number.

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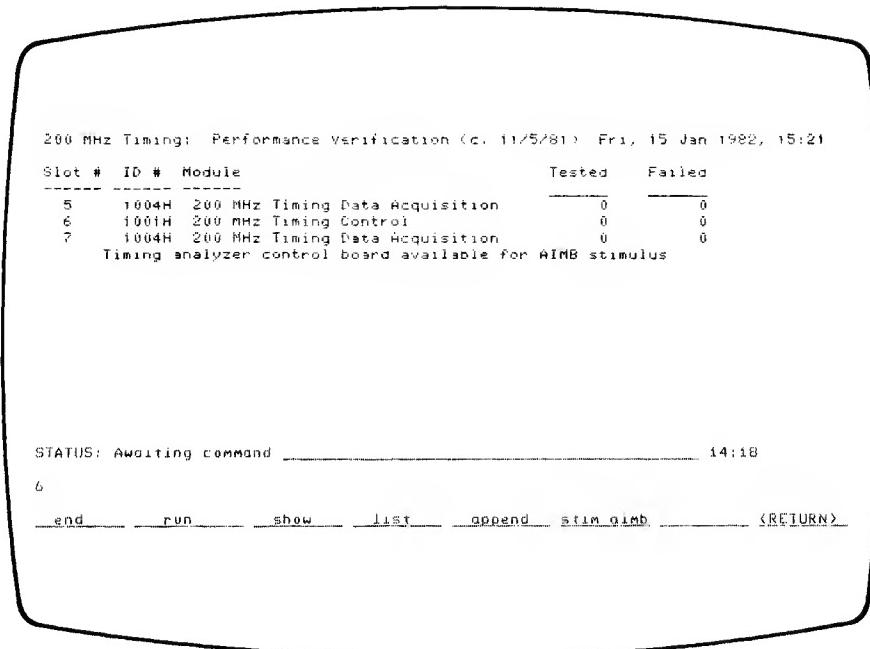


Figure 4-20. Press "run".

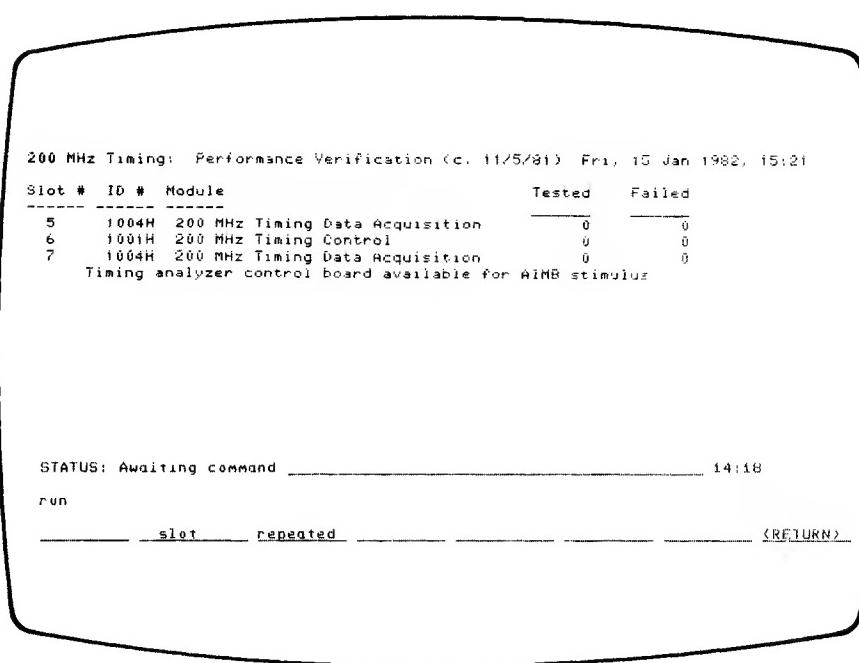


Figure 4-21. Press "slot".

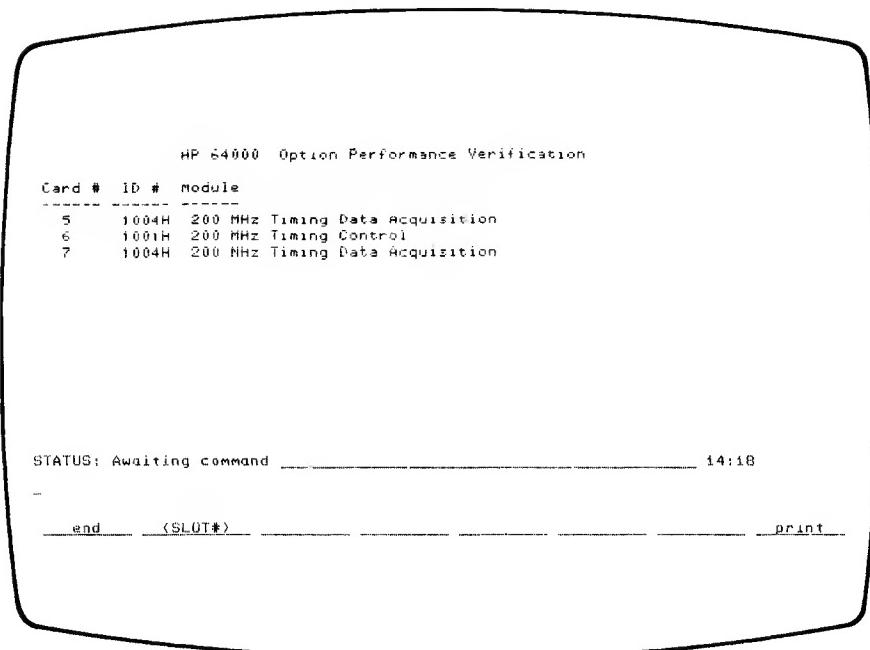


Figure 4-22. Type the slot number.

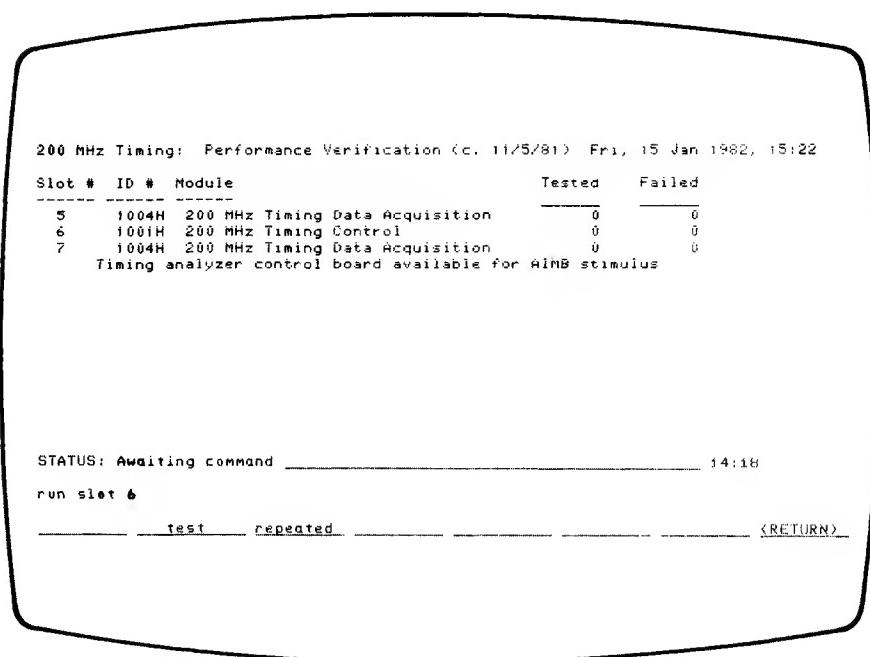


Figure 4-23. Press "test".

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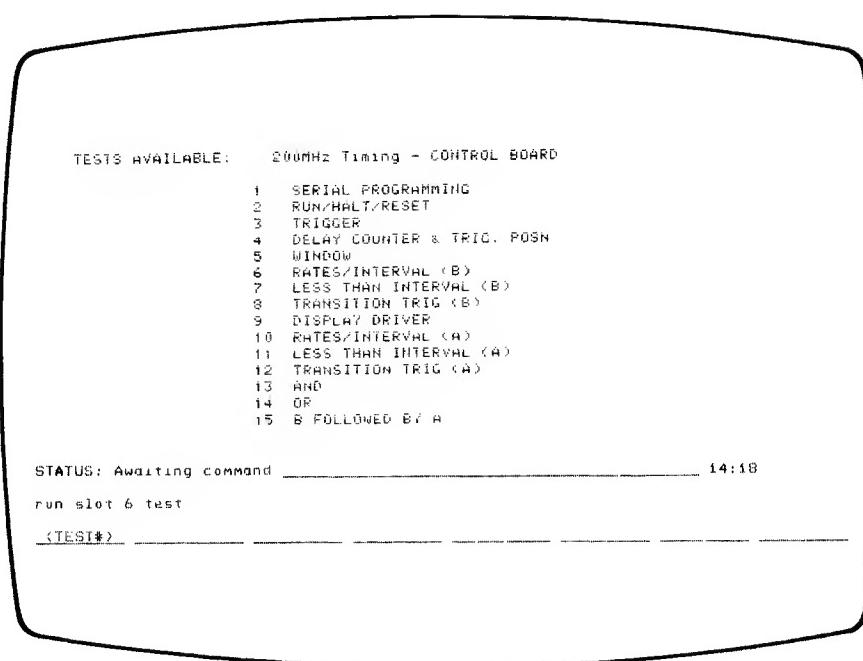


Figure 4-24. Type the test number.

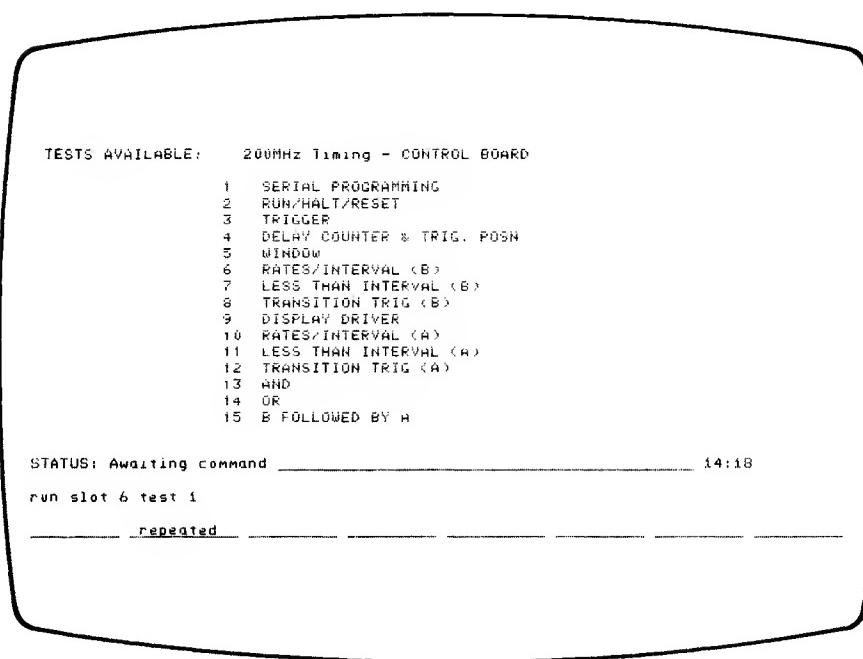


Figure 4-25. Press "repeated".

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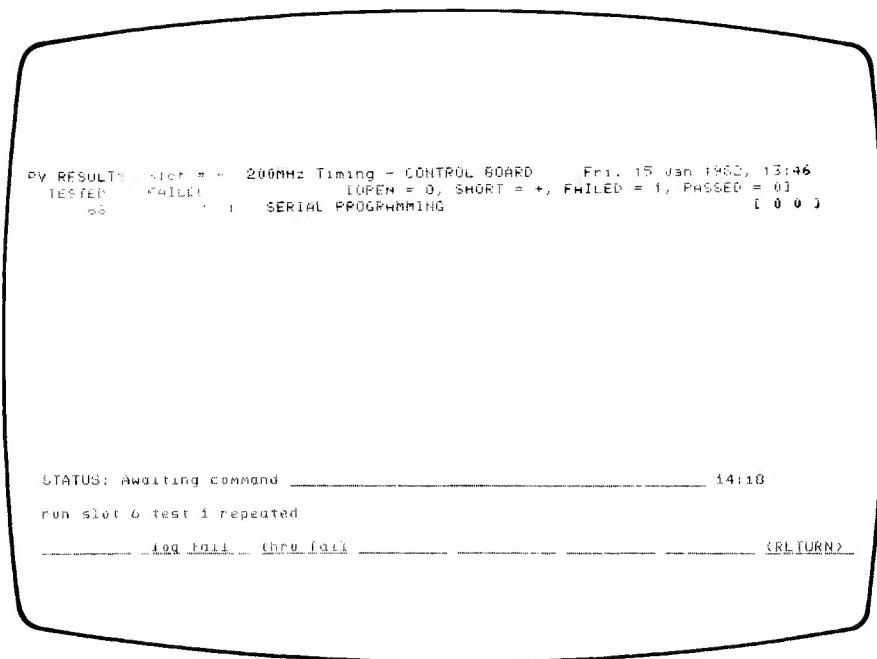


Figure 4-26. Press [RETURN].

4-90. SIGNATURE ANALYSIS

4-91. The following 15 signature loops correspond to the previously given performance verification tests. That is, if a PV test fails, run the signature loop corresponding to that test. For example, if one of the test steps for TEST 1: SERIAL PROGRAMMING shows a "1" instead of a "0" in the bracket, look at the signatures for LOOP 1. In order to take the signatures, run TEST 1 repeatedly, using the procedure illustrated by the above figures (4-18 to 4-26).

64601A Timing Control Board  
SERIAL PROGRAMMING #1

NORM MODE

VH = 8H96

DATA THRESHOLD HIGH: ttl & ecl  
CLOCK THRESHOLD: ttl  
ST-SP-QL THRESHOLD: ttl

Location of ST/SP/START:	tp 12	neg. edge
Location of QUAL/STOP:	tp 12	pos. edge
Location of CLOCK:	tp 11	neg. edge
Location of GROUND:	gnd	

## TTL

U 49- 4	A418	U 89- 1	8H96
U 49- 5	low	(TOTLZ=0781)	
U 49-12	low	U 89- 2	low
U 49-13	H75A	U 89- 3	UP50
U 85- 1	62CA	U 89- 4	8H96
U 85- 2	A418	(TOTLZ=0781)	
U 85- 3	UP50	U 89- 5	low
U 85- 4	low	U 89- 6	3C12
U 85- 5	117F	U 91- 1	2471
U 85- 6	low	U 91- 2	2471
U 85- 7	UP50	U 91- 3	FC5H
U 85- 8	low	U 91- 4	0000
U 85- 9	UP50	(TOTLZ=12257)	
U 85-11	low	U 91- 5	0000
U 85-12	UP50	(TOTLZ=0781)	(TOTLZ=0520)
U 85-13	low	U 91- 6	high
U 85-14	UP50	U 91- 7	46FC
U 85-15	high	U 91- 9	high
U 85-16	UP50	U 91-10	high
U 85-17	low	U 91-11	high
U 85-18	3C12	U 91-12	62CA
U 85-19	62CA	U 91-13	high
U 86- 5	73F6	U 91-14	high
U 86- 6	high	U 91-15	2471
U 86- 7	2471	U101- 8	73F6
U 86-10	low	U101- 9	UP50
U 86-11	high		
U 88- 1	low		
U 88- 2	high		
U 88- 3	0000		
(TOTLZ=0781)			
U 88- 4	8H96		
(TOTLZ=0781)			
U 88- 5	0000		
(TOTLZ=12257)			
U 88- 6	0000		
(TOTLZ=0781)			

## ECL

U 1- 1	0000
(TOTLZ=0520)	
U 1- 3	0051
U 1- 4	P2CA
U 1- 6	high
U 1- 7	low
U 1- 8	low
U 1- 9	low
U 1-10	low
U 1-12	A9P7
U 1-13	high
U 1-14	A9P7
U 1-15	high
U 1-17	0000
(TOTLZ=0520)	
U 1-18	low
U 1-19	high
U 1-20	high
U 1-24	high
U 4- 7	1776
U 4- 9	6U9C
U 4-14	A9P7
U 5- 4	A418
U 10- 1	high
U 10- 2	6U9C
U 10- 3	1776
U 10- 4	5A1U
U 10- 5	16CC
U 10- 6	6U9C
U 10- 7	1776
U 10- 9	A9P7
U 10-10	5A1U
U 10-11	40PF
U 10-12	P284
U 10-13	40PF
U 10-14	P284
U 10-15	9874
U 11- 1	high

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U 11- 2 AF14	U 36- 6 high	U 42-12 3AF1
U 11- 3 C6FF	U 36- 7 low	U 43- 4 3AF1
U 11- 4 HAHH	U 36- 8 low	U 43- 7 C88U
U 11- 5 9249	U 36- 9 low	U 49- 3 A418
U 11- 6 AF14	U 36-10 A418	U 49- 7 low
U 11- 7 C6FF	U 36-12 A9P7	U 49-11 low
U 11- 9 A9P7	U 36-13 high	U 49-15 H75A
U 11-10 HAHH	U 36-14 A9P7	U 50- 9 6AHC
U 11-11 148A	U 36-15 high	U 54- 5 C33H
U 11-12 6HC6	U 36-17 0000	U 54- 6 C7PF
U 11-13 148A	(TOTLZ=0520)	U 54-11 79P0
U 11-14 6HC6	U 36-18 low	U 55- 4 9249
U 11-15 96AH	U 36-19 high	U 55-11 0051
U 13- 4 HAHH	U 36-20 high	U 55-13 F145
U 13- 7 148A	U 36-24 high	U 67- 6 6C36
U 13-11 6HC6	U 37- 1 0000	U 67-11 2HUU
U 13-13 96AH	(TOTLZ=0520)	U 69- 3 A9P7
U 15- 1 high	U 37- 3 6AHC	U 69- 6 A9P7
U 15- 2 3AF1	U 37- 4 0051	U 69- 7 high
U 15- 3 C88U	U 37- 6 high	U 71- 1 high
U 15- 4 8FC6	U 37- 7 low	U 71- 2 2HUU
U 15- 5 96AH	U 37- 8 15P2	U 71- 3 6C36
U 15- 6 3AF1	U 37- 9 H75A	U 71- 4 1363
U 15- 7 C88U	U 37-10 low	U 71- 5 79P0
U 15- 9 A9P7	U 37-12 A9P7	U 71- 6 2HUU
U 15-10 8FC6	U 37-13 high	U 71- 7 6C36
U 15-11 PCPH	U 37-14 A9P7	U 71- 9 A9P7
U 15-12 F711	U 37-15 high	U 71-10 1363
U 15-13 PCPH	U 37-17 0000	U 71-11 H985
U 15-14 F711	(TOTLZ=0520)	U 71-12 F145
U 15-15 16CC	U 37-18 low	U 71-13 H985
U 17- 3 P09C	U 37-19 high	U 71-14 F145
U 17- 4 8FC6	U 37-20 high	U 71-15 9249
U 17- 7 PCPH	U 37-24 high	U 73- 1 high
U 17-11 F711	U 38- 1 0000	U 73- 2 0178
U 17-13 16CC	(TOTLZ=0520)	U 73- 3 802P
U 19- 7 H985	U 38- 3 9824	U 73- 4 H9C9
U 21- 6 H9C9	U 38- 4 6AHC	U 73- 5 73F6
U 21-10 802P	U 38- 6 high	U 73- 6 0178
U 21-12 1363	U 38- 7 low	U 73- 7 802P
U 24- 5 P2CA	U 38- 8 low	U 73- 9 A9P7
U 24- 7 P2CA	U 38- 9 high	U 73-10 H9C9
U 24-11 40PF	U 38-10 80C2	U 73-11 C33H
U 24-12 5A1U	U 38-12 A9P7	U 73-12 C7PF
U 27- 4 AF14	U 38-13 high	U 73-13 C33H
U 27- 6 8H49	U 38-14 A9P7	U 73-14 C7PF
U 27- 7 C6FF	U 38-15 high	U 73-15 79P0
U 34-13 P284	U 38-17 0000	U 74-10 0178
U 35- 7 P284	(TOTLZ=0520)	U 74-11 A069
U 35-13 P284	U 38-18 low	U 74-13 high
U 36- 1 0000	U 38-19 high	U 74-14 high
(TOTLZ=0520)	U 38-20 high	U 86- 2 73F6
U 36- 3 P2CA	U 38-24 high	U 86- 3 A9P7
U 36- 4 A418	U 42- 6 AF14	

## Performance Tests and Troubleshooting - Model 64601A

64601A Timing Control Board  
RUN / HALT / RESET      #2

NORM MODE                    VH = 01UF

DATA THRESHOLD HIGH: ttl & ecl

CLOCK THRESHOLD: ttl

ST-SP-QL THRESHOLD: ttl

Location of ST/SP/START:	tp 12	neg. edge
Location of QUAL/STOP:	tp 12	pos. edge
Location of CLOCK:	tp 11	pos. edge
Location of GROUND:	gnd	

TTL

U 85- 1	01UF	U 91- 1	01UF	U 1- 1	low
(TOTLZ=0002)		(TOTLZ=0137)		U 1- 3	high
U 85- 2	low	U 91- 2	01UF	U 1- 4	low
U 85- 3	01UF	(TOTLZ=0119)		U 1- 6	high
U 85- 4	low	U 91- 3	01AH	U 1- 7	low
U 85- 5	01UF	U 91- 4	01UF	U 1-12	low
U 85- 6	low	(TOTLZ=0255)		U 1-13	0002
U 85- 7	01UF	U 91- 5	0000	U 1-14	low
U 85- 8	low	(TOTLZ=0011)		U 1-15	high
U 85- 9	01UF	U 91- 6	high	U 1-17	low
U 85-12	01UF	U 91- 7	01UF	U 1-18	low
U 85-14	01UF	(TOTLZ=0004)		U 1-19	high
U 85-15	019F	U 91- 9	high	U 1-20	high
U 85-16	01UF	U 91-10	high	U 1-24	0002
U 85-17	low	U 91-11	high	U 5- 5	0002
U 85-18	01UF	U 91-12	01UF	U 5-13	0002
U 85-19	01UF	(TOTLZ=0002)		U 19- 9	0002
(TOTLZ=0002)		U 91-13	high	U 19-13	0002
U 86- 5	0000	U 91-14	high	U 21-13	0002
U 86- 7	high	U 91-15	high	U 22- 9	0002
U 86-10	01UP	U101- 8	0000	U 23- 4	0002
U 86-11	019F	U101- 9	01UF	U 23-12	0002
U 90- 1	015H			U 36- 1	low
U 90- 2	01U2			U 36- 3	low
U 90- 3	0153			U 36- 4	low
U 90- 4	low			U 36- 6	high
U 90- 5	01UP			U 36- 7	low
U 90- 6	019F			U 36- 8	0000
U 90- 7	low			U 36- 9	low
U 90- 9	low			U 36-10	low
U 90-10	low			U 36-12	low
U 90-11	low			U 36-13	0002
U 90-12	high			U 36-14	low
U 90-13	003C			U 36-15	high
U 90-14	01UF			U 36-17	low
(TOTLZ=0004)				U 36-18	low
U 90-15	high			U 36-19	high
				U 36-20	high

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U 36-24 0002  
U 37- 1 low  
U 37- 3 high  
U 37- 4 high  
U 37- 6 high  
U 37- 7 low  
U 37- 9 low  
U 37-10 low  
U 37-12 low  
U 37-13 0002  
U 37-14 low  
U 37-15 high  
U 37-17 low  
U 37-18 low  
U 37-19 high  
U 37-20 high  
U 37-24 0002  
U 38- 1 low  
U 38- 3 low  
U 38- 4 high  
U 38- 6 high  
U 38- 7 low  
U 38- 8 0000  
(TOTLZ=0432)  
U 38- 9 high  
U 38-10 high  
U 38-12 low  
U 38-13 0002  
U 38-14 low  
U 38-17 low  
U 38-18 low  
U 38-19 high  
U 38-20 high  
U 38-24 0002  
U 51- 4 0002  
U 51-12 0002  
U 52-12 0002  
U 66- 4 0002  
U 66-11 0002  
U 67- 5 0002  
U 67- 9 0002  
U 67-12 0002  
U 69- 7 0002  
U 69- 9 0060  
U 69-10 0002  
U 69-11 0002  
U 69-12 019F  
U 69-13 high  
U 69-14 019F  
U 74-13 0002  
U 86- 2 0000  
U 86- 3 low  
U 86-12 0002  
U 86-14 019F

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64601A Timing Control Board  
TRIGGER #3

NORM MODE

VH = 8267

DATA THRESHOLD HIGH: ttl & ecl  
CLOCK THRESHOLD: ttl  
ST-SP-QL THRESHOLD: ttl

Location of ST/SP/START:	tp 12	neg. edge
Location of QUAL/STOP:	tp 12	pos. edge
Location of CLOCK:	tp 11	neg. edge
Location of GROUND:	gnd	

TTL

U 49- 4	8195
U 49- 5	5P64
U 49-12	CFA9
U 49-13	1U26
U 85- 1	HU0C
U 85- 2	8195
U 85- 3	7416
U 85- 4	5P64
U 85- 5	F282
U 85- 6	low
U 85- 7	5663
U 85- 8	low
U 85- 9	723H
U 85-11	2CP3
U 85-12	U3HC
U 85-13	low
U 85-14	U3PS
U 85-15	6P07
U 85-16	3372
U 85-17	CFA9
U 85-18	59UA
U 85-19	HU0C
U 86- 5	0093
U 86- 7	4730
U 86-10	5P64
U 86-11	6P07
U 90- 1	P673
U 90- 2	P67A
U 90- 3	5471
U 90- 4	low
U 90- 5	5P64
U 90- 6	6P07
U 90-12	high
U 90-13	CH35
U 90-14	1725
U 90-15	high
U 91- 1	F82P
U 91- 2	4730

ECL

U 1- 1	0000
(TOTLZ=0260)	
U 1- 3	3314
U 1- 4	820A
U 1- 6	high
U 1- 7	low
U 1-12	F557
U 1-13	HF03
U 1-14	F557
U 1-15	high
U 1-17	0000
(TOTLZ=0260)	
U 1-18	low
U 1-19	high
U 1-20	high
U 1-24	HF03
U 10- 1	high
U 10- 2	3213
U 10- 3	9909
U 10- 4	0CC4
U 10- 5	57U1
U 10- 6	3213
U 10- 7	9909
U 10- 9	F557
U 10-10	0CC4
U 10-11	81CP
U 10-12	87PU
U 10-13	81CP
U 10-14	87PU
U 10-15	4793
U 11- 1	high
U 11- 2	93AA
U 11- 3	F9H5
U 11- 4	CP55
U 11- 5	1F4C
U 11- 6	93AA
U 11- 7	F9H5
U 11- 9	F557

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U 11-10	CP55	U 19-10	CFA9	U 32-11	4.99	DCV
U 11-11	F6F1	U 19-11	high	U 32-12	0.17	DCV
U 11-12	P360	U 19-12	low	U 32-13	0.01	DCV
U 11-13	F6F1	U 19-13	HF03	U 32-14	4.99	DCV
U 11-14	P360	U 19-14	low	U 34- 1	high	
U 11-15	2C0U	U 21- 1	high	U 34- 2	810C	
U 13- 1	high	U 21- 2	87FF	U 34- 3	036F	
U 13- 2	06P4	U 21- 3	5P64	U 34- 4	810C	
U 13- 3	8483	U 21- 5	05AC	U 34- 6	52C2	
U 13- 4	CP55	U 21- 6	032U	U 34- 7	H0H5	
U 13- 5	low	U 21- 7	3PFPP	U 34- 9	52C2	
U 13- 6	low	U 21-10	80U6	U 34-11	0000	
U 13- 7	F6F1	U 21-11	141U	U 34-12	0000	
U 13- 9	low	U 21-12	AU7A	U 34-13	87PU	
U 13-10	P2FH	U 21-13	HF03	U 34-14	0588	
U 13-11	P360	U 21-14	F6CA	U 35- 1	high	
U 13-12	0A14	U 21-15	P2FH	U 35- 2	036F	
U 13-13	2C0U	U 27- 1	high	U 35- 3	810C	
U 13-14	0A14	U 27- 2	8267	U 35- 4	0588	
U 13-15	low	U 27- 3	CFFC	U 35- 5	06P4	
U 15- 1	high	U 27- 4	93AA	U 35- 6	8483	
U 15- 2	0F6F	U 27- 6	810C	U 35- 7	87PU	
U 15- 3	0636	U 27- 7	F9H5	U 35- 9	low	
U 15- 4	59A4	U 27- 9	8267	U 35-10	0588	
U 15- 5	2C0U	U 27-11	036F	U 35-11	H55H	
U 15- 6	0F6F	U 27-12	036F	U 35-12	573A	
U 15- 7	0636	U 27-13	810C	U 35-13	87PU	
U 15- 9	F557	U 27-14	810C	U 35-14	52C2	
U 15-10	59A4	U 31- 1	-4.52 DCV	U 35-15	H0H5	
U 15-11	3539	U 31- 2	-5.17 DCV	U 36- 1	0000	
U 15-12	1A9F	U 31- 3	-5.09 DCV	(TOTLZ=0260)		
U 15-13	3539	U 31- 4	-5.17 DCV	U 36- 3	820A	
U 15-14	1A9F	U 31- 5	-4.37 DCV	U 36- 4	8195	
U 15-15	57U1	U 31- 6	-4.99 DCV	U 36- 6	high	
U 17- 1	high	U 31- 7	-5.17 DCV	U 36- 7	low	
U 17- 2	H55H	U 31- 8	-5.17 DCV	U 36- 8	2CP3	
U 17- 3	573A	U 31- 9	-1.78 DCV	U 36- 9	2CP3	
U 17- 4	59A4	U 31-10	0.17 DCV	U 36-10	8195	
U 17- 5	low	U 31-11	0.01 DCV	U 36-12	F557	
U 17- 6	low	U 31-12	-5.17 DCV	U 36-13	HF03	
U 17- 7	3539	U 31-13	0.65 DCV	U 36-14	F557	
U 17- 9	low	U 31-14	0.01 DCV	U 36-15	high	
U 17-10	P2FH	U 31-15	-4.1 DCV	U 36-17	0000	
U 17-11	1A9F	U 31-16	-4.52 DCV	(TOTLZ=0260)		
U 17-12	0A14	U 32- 1	4.99 DCV	U 36-18	low	
U 17-13	57U1	U 32- 2	0.17 DCV	U 36-19	high	
U 17-14	0A14	U 32- 3	0.01 DCV	U 36-20	high	
U 17-15	low	U 32- 4	0.17 DCV	U 36-24	HF03	
U 19- 1	high	U 32- 5	4.99 DCV	U 37- 1	0000	
U 19- 2	3PFPP	U 32- 6	0.17 DCV	(TOTLZ=0260)		
U 19- 3	05AC	U 32- 7	0.01 DCV	U 37- 3	133A	
U 19- 5	CFA9	U 32- 8	4.99 DCV	U 37- 4	3314	
U 19- 7	4A32	U 32- 9	0.17 DCV	U 37- 6	high	
U 19- 9	HF03	U 32-10	0.01 DCV	U 37- 7	low	

**Performance Tests and Troubleshooting - Model 64601A**

U 37- 8	PP17	U 42-11	4USF	U 50- 9	133A
U 37- 9	1U26	U 42-12	0F6F	U 50-10	low
U 37-10	7U42	U 42-13	52C2	U 50-11	3PFP
U 37-12	F557	U 42-14	CP03	U 50-12	high
U 37-13	HF03	U 42-15	3F64	U 50-14	5P64
U 37-14	F557	U 43- 1	high	U 51- 1	high
U 37-15	high	U 43- 2	high	U 51- 2	2CP3
U 37-17	0000	U 43- 3	4U5F	U 51- 4	HF03
(TOTLZ=0260)		U 43- 4	0F6F	U 51- 6	A984
U 37-18	low	U 43- 6	52C2	U 51- 7	5P64
U 37-19	high	U 43- 7	0636	U 51-10	A984
U 37-20	high	U 43- 9	high	U 51-11	5P64
U 37-24	HF03	U 43-11	H0H5	U 51-12	HF03
U 38- 1	0000	U 43-12	H0H5	U 51-14	low
(TOTLZ=0260)		U 43-13	52C2	U 52- 1	high
U 38- 3	4793	U 43-14	52C2	U 52- 2	low
U 38- 4	133A	U 46- 1	-4.53 DCV	U 52- 3	2CP3
U 38- 6	high	U 46- 2	-5.17 DCV	U 52- 5	high
U 38- 7	low	U 46- 3	-5.11 DCV	U 52- 6	2CP3
U 38- 8	2CP3	U 46- 4	-5.17 DCV	U 52-12	HF03
U 38- 9	high	U 46- 5	-4.37 DCV	U 52-13	A984
U 38-10	98A2	U 46- 6	-4.97 DCV	U 54- 1	high
U 38-12	F557	U 46- 7	-5.17 DCV	U 54- 2	FPC5
U 38-13	HF03	U 46- 8	-5.17 DCV	U 54- 3	FPC5
U 38-14	F557	U 46- 9	-1.76 DCV	U 54- 4	98A2
U 38-15	high	U 46-10	0.16 DCV	U 54- 5	187F
U 38-17	0000	U 46-11	0.01 DCV	U 54- 6	5681
(TOTLZ=0260)		U 46-12	-5.17 DCV	U 54- 7	87FF
U 38-18	low	U 46-13	0.64 DCV	U 54- 9	HF03
U 38-19	high	U 46-14	0.01 DCV	U 54-10	F6CA
U 38-20	high	U 46-15	-4.37 DCV	U 54-11	P814
U 38-24	HF03	U 46-16	-4.53 DCV	U 54-12	FPC5
U 39- 1	PP17	U 47- 1	4.99 DCV	U 54-13	low
U 39- 5	A984	U 47- 2	0.16 DCV	U 54-14	FPC5
U 39- 6	low	U 47- 3	0.01 DCV	U 54-15	4FH2
U 39- 9	4793	U 47- 4	0.16 DCV	U 55- 1	high
U 40- 1	high	U 47- 5	4.99 DCV	U 55- 2	1U26
U 40- 3	0000	U 47- 6	0.16 DCV	U 55- 4	1F4C
(TOTLZ=0003)		U 47- 7	0.01 DCV	U 55- 5	9H49
U 40- 5	HF03	U 47- 8	4.99 DCV	U 55- 6	low
U 40- 7	0000	U 47- 9	0.16 DCV	U 55- 7	low
U 40- 9	A984	U 47-10	0.01 DCV	U 55- 9	4FH2
U 40-10	2CP3	U 47-11	4.99 DCV	U 55-10	low
U 40-11	0000	U 47-12	0.16 DCV	U 55-11	3314
U 40-12	HF03	U 47-13	0.01 DCV	U 55-12	P2FH
U 40-14	2CP3	U 47-14	4.99 DCV	U 55-13	3896
U 42- 1	high	U 49- 3	8195	U 55-14	CP03
U 42- 3	9H49	U 49- 7	5P64	U 55-15	low
U 42- 4	high	U 49-11	CFA9	U 66- 1	high
U 42- 5	CFFC	U 49-15	1U26	U 66- 2	5P64
U 42- 6	93AA	U 50- 1	high	U 66- 3	HF03
U 42- 7	810C	U 50- 2	5P64	U 66- 4	HF03
U 42- 9	low	U 50- 4	5P64	U 66- 5	7U42
U 42-10	high	U 50- 7	low	U 66- 6	5P64

Performance Tests and Troubleshooting - Model 64601A

U 66- 7	low		U 73- 9	F557
U 66- 9	low		U 73-10	032U
U 66-10	98A2		U 73-11	187F
U 66-11	HF03		U 73-12	5681
U 66-12	low		U 73-13	187F
U 66-13	high		U 73-14	5681
U 66-14	6099		U 73-15	P814
U 66-15	5P64		U 74- 1	high
U 67- 1	high		U 74- 2	P2FH
U 67- 2	P2FH		U 74- 4	HF03
U 67- 3	CFA9		U 74- 5	P2FH
U 67- 4	3F64		U 74-10	8U8H
U 67- 5	HF03		U 74-11	141U
U 67- 6	563F		U 74-12	low
U 67- 7	HF03		U 74-13	HF03
U 67- 9	HF03		U 74-14	high
U 67-10	5P64		U 86- 2	0093
U 67-11	2AH1		U 86- 3	F557
U 67-12	HF03		U 86-12	HF03
U 67-14	141U		U 86-14	A984
U 69- 1	high			
U 69- 2	low			
U 69- 3	F557			
U 69- 4	8U8H			
U 69- 5	CFA9			
U 69- 6	F557			
U 69- 7	6P01			
U 69- 9	2CP3			
U 69-10	HF03			
U 69-11	HF03			
U 69-12	A984			
U 69-13	high			
U 69-14	A984			
U 71- 1	high			
U 71- 2	2AH1			
U 71- 3	563F			
U 71- 4	AU7A			
U 71- 5	P814			
U 71- 6	2AH1			
U 71- 7	563F			
U 71- 9	F557			
U 71-10	AU7A			
U 71-11	4A32			
U 71-12	3896			
U 71-13	4A32			
U 71-14	3896			
U 71-15	1F4C			
U 73- 1	high			
U 73- 2	8U8H			
U 73- 3	80U6			
U 73- 4	032U			
U 73- 5	0093			
U 73- 6	8U8H			
U 73- 7	80U6			

Performance Tests and Troubleshooting - Model 64601A

64601A Timing Control Board  
DELAY COUNTER & TRIG POSITION #4

NORM MODE VH = 5525

DATA THRESHOLD HIGH: ttl & ecl  
CLOCK THRESHOLD: ttl  
ST-SP-QL THRESHOLD: ttl

Location of ST/SP/START:	tp 12	neg. edge
Location of QUAL/STOP:	tp 12	pos. edge
Location of CLOCK:	tp 11	neg. edge
Location of GROUND:	gnd	

TTL

U 49- 4	3H26	U 91- 3	HC07
U 49- 5	7331	U 91- 4	0000
U 49-12	CU81	(TOTLZ=0199)	
U 49-13	38UU	U 91- 5	0000
U 64- 4	low	U 91- 6	high
U 64- 5	3PP9	U 91- 7	8P22
U 64-12	584U	U 91-12	5531
U 64-13	CU81	U 91-13	H6U7
U 85- 1	5531	U 91-15	58F1
U 85- 2	3H26	U101- 8	1FH6
U 85- 3	75P9	U101- 9	49U3
U 85- 4	7331		
U 85- 5	6H2U		
U 85- 6	UH28		
U 85- 7	0052		
U 85- 8	CU81		
U 85- 9	P53H		
U 85-11	584U		
U 85-12	7742		
U 85-13	3PP9		
U 85-14	7396		
U 85-15	4019		
U 85-16	6HUU		
U 85-17	CU81		
U 85-18	62F1		
U 85-19	5531		
U 90- 1	C1CP		
U 90- 2	9205		
U 90- 3	7195		
U 90- 4	low		
U 90- 5	H517		
U 90- 6	4019		
U 90-12	high		
U 90-13	6H3H		
U 90-14	8P22		
U 90-15	high		
U 91- 1	HC13		
U 91- 2	58F1		

ECL

U 7- 1	high
U 7- 2	23P7
U 7- 3	76F2
U 7- 4	23P7
U 7- 5	76F2
U 7- 9	23P7
U 7-10	76F2
U 7-12	23P7
U 7-13	76F2
U 7-15	76F2
U 36- 1	0000
U 36- 3	25HC
U 36- 6	high
U 36- 7	low
U 36- 8	66A6
U 36- 9	0080
U 36-12	P5A1
U 36-13	8032
U 36-14	P5A1
U 36-15	high
U 36-17	0000
U 36-18	low
U 36-19	high
U 36-20	high
U 36-24	8032
U 37- 1	0000
U 37- 3	1P20
U 37- 4	UH94
U 37- 6	high
U 37- 7	low
U 37- 8	920C
U 37- 9	38UU
U 37-10	0000
U 37-12	P5A1
U 37-13	8032
U 37-14	P5A1
U 37-15	high
U 37-17	0000

## Performance Tests and Troubleshooting - Model 64601A

U 37-18	low		U 52- 1	high
U 37-19	high		U 52- 2	3PP9
U 37-20	high		U 52- 3	584U
U 37-24	8032		U 52- 5	high
U 38- 1	0000		U 52- 6	0080
U 38- 3	P4F9		U 52-12	8032
U 38- 4	1P20		U 52-13	76F2
U 38- 6	high		U 55- 1	high
U 38- 7	low		U 55- 2	38UU
U 38- 8	66A6		U 55- 4	78FF
U 38- 9	high		U 55- 5	0P1U
U 38-10	F708		U 55- 6	low
U 38-12	P5A1		U 55- 7	low
U 38-13	8032		U 55- 9	2U62
U 38-14	P5A1		U 55-10	low
U 38-15	high		U 55-11	UH94
U 38-17	0000		U 55-12	6A96
U 38-18	low		U 55-13	0PU7
U 38-19	high		U 55-14	70C3
U 38-20	high		U 64- 3	0000
U 38-24	8032		U 64- 7	3PP9
U 40- 1	high		U 64-11	584U
U 40- 3	P7FP		U 64-15	CU81
U 40- 5	8032		U 66- 1	high
U 40- 7	P7FP		U 66- 2	7331
U 40- 9	76F2		U 66- 3	2614
U 40-10	66A6		U 66- 4	8032
U 40-11	P7FP		U 66- 5	0000
U 40-12	8032		U 66- 6	H517
U 40-14	66A6		U 66-10	F708
U 49- 3	3H26		U 66-11	8032
U 49- 7	7331		U 66-15	H517
U 49-11	CU81			
U 49-15	38UU			
U 50- 1	high			
U 50- 2	7331			
U 50- 4	7331			
U 50- 7	low			
U 50- 9	1P20			
U 50-10	low			
U 50-11	PAA4			
U 50-12	high			
U 50-14	7331			
U 51- 1	high			
U 51- 2	0080			
U 51- 4	8032			
U 51- 6	76F2			
U 51- 7	7331			
U 51- 9	low			
U 51-10	76F2			
U 51-11	7331			
U 51-12	8032			
U 51-14	CU81			
U 51-15	high			

Performance Tests and Troubleshooting - Model 64601A

64601A Timing Control Board  
WINDOW COUNTER #5

NORM MODE

VH = 13H2

DATA THRESHOLD HIGH: ttl & ecl  
CLOCK THRESHOLD: ttl  
ST-SP-QL THRESHOLD: ttl

Location of ST/SP/START: tp 12 neg. edge  
Location of QUAL/STOP: tp 12 pos. edge  
Location of CLOCK: tp 11 neg. edge  
Location of GROUND: gnd

TTL

U 49- 4	CH73	U 90-10	low
U 49- 5	A5U7	U 90-11	low
U 49-12	low	U 90-12	high
U 49-13	A0P9	U 90-13	46HH
U 64- 4	low	U 90-14	551S
U 64- 5	A5A9	U 90-15	high
U 64-12	8F85	U 91- 1	C50A
U 64-13	low	U 91- 2	6A7U
U 85- 1	P01U	U 91- 3	46F7
U 85- 2	CH73	U 91- 4	0000
U 85- 3	8226	U 91- 5	0000
U 85- 4	A5U7	U 91- 6	high
U 85- 5	P8F9	U 91- 7	551S
U 85- 6	429A	U 91- 9	high
U 85- 7	H641	U 91-10	high
U 85- 8	low	U 91-11	high
U 85- 9	37H6	U 91-12	P01U
U 85-11	8F85	U 91-13	FFA7
U 85-12	C62A	U 91-14	high
U 85-13	A5A9	U 91-15	6A7U
U 85-14	OPFU		
U 85-15	5284		
U 85-16	0UU2		
U 85-17	low		
U 85-18	1921		
U 85-19	P01U		
U 86- 5	49U6		
U 86- 7	6A7U		
U 86-10	C6HA		
U 86-11	5284		
U 90- 1	C8A2		
U 90- 2	8485		
U 90- 3	4U2P		
U 90- 4	low		
U 90- 5	C6HA		
U 90- 6	5284		
U 90- 7	low		
U 90- 9	low		

ECL

U 7- 1	high
U 7- 2	FU99
U 7- 3	HF4C
U 7- 4	FU99
U 7- 5	HF4C
U 7- 9	FU99
U 7-10	HF4C
U 7-11	0000
U 7-12	FU99
U 7-13	HF4C
U 7-15	HF4C
U 19- 1	high
U 19- 2	high
U 19- 3	3FA7
U 19- 4	low
U 19- 5	low
U 19- 7	CC99
U 19- 9	A508
U 19-10	low
U 19-11	high
U 19-12	low
U 19-13	A508
U 19-14	low
U 19-15	13H2
U 21- 1	high
U 21- 2	2075
U 21- 3	A5U7
U 21- 4	low
U 21- 5	3FA7
U 21- 6	F583
U 21- 7	high
U 21-10	CU70
U 21-11	6CA8
U 21-12	7733
U 21-13	A508
U 21-14	0AU3
U 21-15	C6HA
U 36- 1	0000

Performance Tests and Troubleshooting - Model 64601A

U 36- 3	13AP		U 40- 1	high		U 64-15	low
U 36- 4	CH73		U 40- 3	1UU1		U 66- 1	high
U 36- 6	high		U 40- 4	low		U 66- 2	A5U7
U 36- 7	low		U 40- 5	A508		U 66- 3	C625
U 36- 8	6PP4		U 40- 6	low		U 66- 4	A508
U 36- 9	869U		U 40- 7	1UU1		U 66- 5	A5U7
U 36-10	CH73		U 40- 9	HF4C		U 66- 6	A5U7
U 36-12	6HH9		U 40-10	6PP4		U 66-10	94PF
U 36-13	A508		U 40-11	1UU1		U 66-11	A508
U 36-14	6HH9		U 40-12	A508		U 66-13	high
U 36-15	high		U 40-13	low		U 66-15	A5U7
U 36-17	0000		U 40-14	6PP4		U 69- 3	6HH9
U 36-18	low		U 49- 3	CH73		U 69- 6	79AH
U 36-19	high		U 49- 7	A5U7		U 69- 7	5284
U 36-20	high		U 49-11	low		U 69- 9	APPF
U 36-24	A508		U 49-15	A0P9		U 69-12	CH3P
U 37- 1	0000		U 50- 1	high		U 86- 2	49U6
U 37- 3	2H21		U 50- 2	A5U7		U 86- 3	79AH
U 37- 4	C41P		U 50- 4	A5U7		U 86-12	A508
U 37- 6	high		U 50- 9	2H21		U 86-14	CH3P
U 37- 7	low		U 50-11	high			
U 37- 8	0C80		U 50-14	A5U7			
U 37- 9	A0P9		U 51- 1	high			
U 37-10	A5U7		U 51- 2	869U			
U 37-12	6HH9		U 51- 4	A508			
U 37-13	A508		U 51- 6	HF4C			
U 37-14	6HH9		U 51- 7	A5U7			
U 37-15	high		U 51-10	HF4C			
U 37-17	0000		U 51-11	A5U7			
U 37-18	low		U 51-12	A508			
U 37-19	high		U 51-14	low			
U 37-20	high		U 52- 1	high			
U 37-24	A508		U 52- 2	A5A9			
U 38- 1	0000		U 52- 3	8F85			
U 38- 3	H7FC		U 52- 5	high			
U 38- 4	2H21		U 52- 6	869U			
U 38- 6	high		U 52-12	A508			
U 38- 7	low		U 52-13	HF4C			
U 38- 8	6PP4		U 55- 1	high			
U 38- 9	high		U 55- 2	A0P9			
U 38-10	94PF		U 55- 4	2PP6			
U 38-12	6HH9		U 55- 5	PHHU			
U 38-13	A508		U 55- 6	low			
U 38-14	6HH9		U 55- 7	low			
U 38-15	high		U 55- 9	FC45			
U 38-17	0000		U 55-10	low			
U 38-18	low		U 55-11	C41P			
U 38-19	high		U 55-12	A5U7			
U 38-20	high		U 55-13	5HFF			
U 38-24	A508		U 55-14	734C			
U 39- 1	0C80		U 55-15	low			
U 39- 5	HF4C		U 64- 3	0000			
U 39- 6	low		U 64- 7	A5A9			
U 39- 9	H7FC		U 64-11	8F85			

Performance Tests and Troubleshooting - Model 64601A

64601A Timing Control Board  
RATES / INTERVAL B #6

NORM MODE

VH = F036

DATA THRESHOLD HIGH: ttl & ecl  
CLOCK THRESHOLD: ttl  
ST-SP-QL THRESHOLD: ttl

Location of ST/SP/START: tp 12 neg. edge  
Location of QUAL/STOP: tp 12 pos. edge  
Location of CLOCK: tp 11 pos. edge  
Location of GROUND: gnd

TTL

U 44- 1	high	U 86- 7	F036
U 44- 2	4999	U 86-10	U7F0
U 44- 3	8CC2	U 86-11	5FA5
U 44- 4	F74C	U 90- 1	2F7F
U 44- 5	159C	U 90- 2	6914
U 44- 6	3P42	U 90- 3	7466
U 44- 7	C88C	U 90- 4	low
U 44- 8	C70H	U 90- 5	U7F0
U 44- 9	0HFA	U 90- 6	5FA5
U 44-11	F036	U 90-13	3299
U 44-12	AUCF	U 90-14	F036
U 44-13	F1F1	U 90-15	high
U 44-14	H3A9	U 91- 1	63C9
U 44-15	3P30	U 91- 2	884H
U 44-16	3078	U 91- 3	947H
U 44-17	3299	U 91- 4	F036
U 44-18	C233	(TOTLZ=0207)	
U 44-19	low	U 91- 5	0000
U 49- 4	692C	U 91- 6	high
U 49- 5	U7F0	U 91- 7	F036
U 49-12	low	(TOTLZ=0001)	
U 49-13	69C9	U 91-12	F036
U 85- 1	F036	U 91-13	F036
U 85- 2	692C	U 91-15	F036
U 85- 3	0P0P		
U 85- 4	U7F0		
U 85- 5	U5PH		
U 85- 6	low		
U 85- 7	U1C5		
U 85- 9	5P4A		
U 85-12	4A31		
U 85-14	6FCU		
U 85-15	5FA5		
U 85-16	CCU5		
U 85-17	low		
U 85-18	H18U		
U 85-19	F036		
U 86- 5	7205		

ECL

U 7- 1	high
U 7- 2	49P7
U 7- 3	89H1
U 7- 4	49P7
U 7- 5	89H1
U 7- 9	49P7
U 7-10	89H1
U 7-12	49P7
U 7-13	89H1
U 7-15	89H1
U 10- 1	high
U 10- 2	6AH1
U 10- 3	9C4H
U 10- 4	8F06
U 10- 5	0877
U 10- 6	6AH1
U 10- 7	9C4H
U 10-10	8F06
U 10-11	8225
U 10-12	045C
U 10-13	8225
U 10-14	045C
U 10-15	460C
U 15- 1	high
U 15- 2	5FA3
U 15- 3	AP51
U 15- 4	3323
U 15- 5	310A
U 15- 6	5FA3
U 15- 7	AP51
U 15-10	3323
U 15-11	39CF
U 15-12	H8U8
U 15-13	39CF
U 15-14	H8U8
U 15-15	0877
U 17- 1	high
U 17- 2	C6CC

Performance Tests and Troubleshooting - Model 64601A

U 17- 3	768H	U 38- 1	0000	U 55-12	U7F0
U 17- 4	3323	U 38- 3	460C	U 55-13	14U6
U 17- 5	low	U 38- 4	UC45	U 55-15	low
U 17- 6	low	U 38- 6	high	U 67- 1	high
U 17- 7	39CF	U 38- 7	low	U 67- 2	U7F0
U 17- 9	low	U 38- 9	high	U 67- 3	low
U 17-10	U7F0	U 38-10	9F01	U 67- 5	37U6
U 17-11	H8U8	U 38-12	0000	U 67- 6	2UUC
U 17-12	0000	U 38-13	37U6	U 67- 7	37U6
U 17-13	0877	U 38-14	0000	U 67- 9	37U6
U 17-14	0000	U 38-15	high	U 67-10	U7F0
U 17-15	low	U 38-17	0000	U 67-11	1UAF
U 34- 1	high	U 38-18	low	U 67-12	37U6
U 34-13	045C	U 38-19	high	U 67-13	low
U 34-14	F46H	U 38-20	high	U 67-14	HU9A
U 34-15	F036	U 38-24	37U6	U 71- 1	high
U 35-10	F46H	U 43- 1	high	U 71- 2	1UAF
U 35-11	C6CC	U 43- 2	high	U 71- 3	2UUC
U 35-12	768H	U 43- 4	5FA3	U 71- 4	53HC
U 35-13	045C	U 43- 5	low	U 71- 5	7U03
U 35-15	72H6	U 43- 7	AP51	U 71- 6	1UAF
U 36- 1	0000	U 43- 9	high	U 71- 7	2UUC
U 36- 3	9U2U	U 43-10	low	U 71-10	53HC
U 36- 4	692C	U 43-11	72H6	U 71-11	29PH
U 36- 6	high	U 43-12	72H6	U 71-12	14U6
U 36- 7	low	U 43-13	C2P0	U 71-13	29PH
U 36- 9	49P7	U 43-14	C2P0	U 71-14	14U6
U 36-10	692C	U 43-15	0000	U 71-15	6P70
U 36-12	0000	U 49- 3	692C	U 73- 1	high
U 36-13	37U6	U 49- 7	U7F0	U 73- 2	FFU8
U 36-14	0000	U 49-11	low	U 73- 3	8277
U 36-15	high	U 49-15	69C9	U 73- 4	P116
U 36-17	0000	U 54- 1	high	U 73- 5	7205
U 36-18	low	U 54- 2	UU48	U 73- 6	FFU8
U 36-19	high	U 54- 3	UU48	U 73- 7	8277
U 36-20	high	U 54- 4	9F01	U 73-10	P116
U 36-24	37U6	U 54- 5	C4AH	U 73-11	C4AH
U 37- 1	0000	U 54- 6	CP5H	U 73-12	CP5H
U 37- 3	UC45	U 54- 7	4HF8	U 73-13	C4AH
U 37- 4	71P0	U 54- 9	37U6	U 73-14	CP5H
U 37- 6	high	U 54-10	267A	U 73-15	7U03
U 37- 7	low	U 54-11	7U03	U 86- 2	7205
U 37- 8	FUHA	U 54-12	UU48	U 86- 3	0000
U 37- 9	69C9	U 54-13	low	U 86-12	37U6
U 37-10	7337	U 54-14	UU48	U 86-14	89H1
U 37-12	0000	U 54-15	3U7P		
U 37-13	37U6	U 55- 1	high		
U 37-14	0000	U 55- 2	69C9		
U 37-15	high	U 55- 4	6P70		
U 37-17	0000	U 55- 6	low		
U 37-18	low	U 55- 7	low		
U 37-19	high	U 55- 9	3U7P		
U 37-20	high	U 55-10	low		
U 37-24	37U6	U 55-11	71P0		

## Performance Tests and Troubleshooting - Model 64601A

64601A Timing Control Board  
LESS THAN INTERVAL R #7

NORM MODE

VH = 593A

DATA THRESHOLD HIGH: ttl &amp; ecl

CLOCK THRESHOLD: ttl

ST-SP-QL THRESHOLD: ttl

Location of ST/SP/START:	tp 12	neg. edge
Location of QUAL/STOP:	tp 12	pos. edge
Location of CLOCK:	tp 11	pos. edge
Location of GROUND:	gnd	

TTL

U 44- 1	high	U 47- 6	0.16 DCV	U 90-14	593A
U 44- 2	low	U 47- 7	0.01 DCV	U 90-15	high
U 44- 3	HHHU	U 47- 8	4.99 DCV	U 91- 1	0583
U 44- 4	4UA2	U 47- 9	0.16 DCV	U 91- 2	C050
U 44- 5	low	U 47-10	0.01 DCV	U 91- 3	05C0
U 44- 6	low	U 47-11	4.99 DCV	U 91- 4	593A
U 44- 7	869F	U 47-12	0.91 DCV	U 91- 5	0000
U 44- 8	5153	U 47-13	0.01 DCV	U 91- 6	high
U 44- 9	low	U 47-14	0.04 DCV	U 91- 7	593A
U 44-11	593A	U 49- 4	8F3U	U 91-12	593A
U 44-12	high	U 49- 5	P7A2	U 91-13	593A
U 44-13	8067	U 49-12	low	U 91-14	high
U 44-14	3F17	U 49-13	F8C7	U 91-15	593A
U 44-15	low	U 85- 1	593A		
U 44-16	high	U 85- 2	8F3U		
U 44-18	8874	U 85- 3	822P		
U 44-19	low	U 85- 4	P7A2		
U 46- 1	-4.53 DCV	U 85- 5	A9A6		
U 46- 2	-5.17 DCV	U 85- 6	9226		
U 46- 3	-5.11 DCV	U 85- 7	FPA8		
U 46- 4	-5.17 DCV	U 85- 9	H6H5		
U 46- 5	-4.36 DCV	U 85-12	7020		
U 46- 6	-4.89 DCV	U 85-14	H780		
U 46- 7	-5.17 DCV	U 85-15	P5AF		
U 46- 8	-5.17 DCV	U 85-16	C197		
U 46- 9	-0.81 DCV	U 85-17	low		
U 46-10	0.16 DCV	U 85-18	A9A8		
U 46-11	0.01 DCV	U 85-19	593A		
U 46-12	-5.17 DCV	U 86- 5	H14P		
U 46-13	0.64 DCV	U 86- 7	593A		
U 46-14	0.01 DCV	U 86-10	9266		
U 46-15	-4.36 DCV	U 86-11	P5AF		
U 46-16	-4.53 DCV	U 90- 1	74F9		
U 47- 1	4.99 DCV	U 90- 2	06HC		
U 47- 2	0.16 DCV	U 90- 3	292H		
U 47- 3	0.01 DCV	U 90- 4	low		
U 47- 4	0.16 DCV	U 90- 5	9266		
U 47- 5	4.99 DCV	U 90- 6	P5AF		

## Performance Tests and Troubleshooting - Model 64601A

### ECL

U 5- 2	" 24 MHz	U 35-13	074F	U 42-12	0U33
U 5- 3	" 24 MHz	U 35-15	18H4	U 43- 1	high
U 7- 2	" 24 MHz	U 36- 1	0000	U 43- 2	high
U 7- 3	" 24 MHz	U 36- 3	224A	U 43- 4	0U33
U 10- 1	high	U 36- 4	8F3U	U 43- 5	low
U 10- 2	F19U	U 36- 6	high	U 43- 7	5831
U 10- 3	3U67	U 36- 7	low	U 43- 9	high
U 10- 4	9UC3	U 36- 9	P7A2	U 43-10	low
U 10- 5	6870	U 36-10	8F3U	U 43-11	18H4
U 10- 6	F19U	U 36-12	0000	U 43-12	18H4
U 10- 7	3U67	U 36-13	FC5F	U 43-13	41PP
U 10-10	9UC3	U 36-14	0000	U 43-14	41PP
U 10-11	P5H6	U 36-15	high	U 49- 3	8F3U
U 10-12	074F	U 36-17	0000	U 49- 7	P7A2
U 10-13	P5H6	U 36-18	low	U 49-11	low
U 10-14	074F	U 36-19	high	U 49-15	F8C7
U 10-15	HF0P	U 36-20	high	U 54- 1	high
U 15- 1	high	U 36-24	FC5F	U 54- 2	AH52
U 15- 2	0U33	U 37- 1	0000	U 54- 3	AH52
U 15- 3	5831	U 37- 3	848H	U 54- 4	2U82
U 15- 4	8617	U 37- 4	116F	U 54- 5	1941
U 15- 5	0528	U 37- 6	high	U 54- 6	A6AU
U 15- 6	0U33	U 37- 7	low	U 54- 7	PF6H
U 15- 7	5831	U 37- 9	F8C7	U 54- 9	FC5F
U 15-10	8617	U 37-10	low	U 54-10	1817
U 15-11	C6AF	U 37-12	0000	U 54-11	26U0
U 15-12	84UP	U 37-13	FC5F	U 54-12	AH52
U 15-13	C6AF	U 37-14	0000	U 54-13	low
U 15-14	84UP	U 37-15	high	U 54-14	AH52
U 15-15	6870	U 37-17	0000	U 54-15	U468
U 17- 1	high	U 37-18	low	U 55- 1	high
U 17- 2	46A2	U 37-19	high	U 55- 2	F8C7
U 17- 3	1U98	U 37-20	high	U 55- 4	A33H
U 17- 4	8617	U 37-24	FC5F	U 55- 6	low
U 17- 5	low	U 38- 1	0000	U 55- 7	low
U 17- 6	low	U 38- 3	HF0P	U 55- 9	U468
U 17- 7	C6AF	U 38- 4	848H	U 55-10	low
U 17- 9	low	U 38- 6	high	U 55-11	116F
U 17-10	low	U 38- 7	low	U 55-12	P7A2
U 17-11	84UP	U 38- 9	high	U 55-13	1264
U 17-12	0000	U 38-10	2U82	U 55-15	low
U 17-13	6870	U 38-12	0000	U 67- 1	high
U 17-14	0000	U 38-13	FC5F	U 67- 2	low
U 17-15	low	U 38-14	0000	U 67- 3	low
U 34- 1	high	U 38-15	high	U 67- 5	FC5F
U 34- 6	90AP	U 38-17	0000	U 67- 6	06F8
U 34-13	074F	U 38-18	low	U 67- 7	CP98
U 34-14	5P76	U 38-19	high	U 67- 9	FC5F
U 34-15	high	U 38-20	high	U 67-10	P7A2
U 35-10	5P76	U 38-24	FC5F	U 67-11	P6HU
U 35-11	46A2	U 42- 9	low	U 67-12	FC5F
U 35-12	1U98	U 42-10	high	U 67-13	low

Performance Tests and Troubleshooting - Model 64601A

U 67-14	C0P5
U 67-15	593A
U 71- 1	high
U 71- 2	P6HU
U 71- 3	06F8
U 71- 4	U6F3
U 71- 5	26U0
U 71- 6	P6HU
U 71- 7	06F8
U 71- 9	0000
U 71-10	U6F3
U 71-11	24F9
U 71-12	1264
U 71-13	24F9
U 71-14	1264
U 71-15	A33H
U 73- 1	high
U 73- 2	C5FP
U 73- 3	U0P8
U 73- 4	8HH3
U 73- 5	H14P
U 73- 6	C5FP
U 73- 7	U0P8
U 73- 9	0000
U 73-10	8HH3
U 73-11	1941
U 73-12	A6AU
U 73-13	1941
U 73-14	A6AU
U 73-15	26U0
U 86- 2	H14P
U 86- 3	0000
U 86-12	FC5F
U 86-14	FC1F

Performance Tests and Troubleshooting - Model 64601A

64601A Timing Control Board  
TRANSITION TRIGGER B #8

NORM MODE

VH = FC27

DATA THRESHOLD HIGH: ttl & ecl

CLOCK THRESHOLD: ttl

ST-SP-QL THRESHOLD: ttl

Location of ST/SP/START:	tp 12	neg. edge
Location of QUAL/STOP:	tp 12	pos. edge
Location of CLOCK:	tp 11	pos. edge
Location of GROUND:	gnd	

TTL

U 49- 4	7P9C	U 91- 4	FC27
U 49- 5	3242	(TOTLZ=0207)	
U 49-12	low	U 91- 5	0000
U 49-13	H916	(TOTLZ=0001)	
U 85- 1	FC27	U 91- 6	high
U 85- 2	7P9C	U 91- 7	FC27
U 85- 3	CUBA	(TOTLZ=0001)	
U 85- 4	3242	U 91- 9	high
U 85- 5	FAAC	U 91-10	high
U 85- 6	3244	U 91-11	high
U 85- 7	86PC	U 91-12	FC27
U 85- 9	2H80	U 91-13	FC27
U 85-12	0P04	U 91-14	high
U 85-14	HAU0	U 91-15	FC27
U 85-15	7FC5		
U 85-16	1632		
U 85-17	low		
U 85-18	5535		
U 85-19	FC27		
U 86- 5	5C83		
U 86- 7	FC27		
U 86-10	324F		
U 86-11	7FC5		
U 90- 1	4P99		
U 90- 2	F0HA		
U 90- 3	4524		
U 90- 4	low		
U 90- 5	324F		
U 90- 6	7FC5		
U 90-12	high		
U 90-13	H458		
U 90-14	FC27		
(TOTLZ=0001)			
U 90-15	high		
U 91- 1	A0C0		
U 91- 2	C7PA		
U 91- 3	A0C7		

ECL

U 7- 1	high
U 7- 2	3242
U 7- 3	U965
U 7- 4	3242
U 7- 5	U965
U 7- 9	3242
U 7-10	U965
U 7-12	3242
U 7-13	U965
U 7-15	U965
U 10- 1	high
U 10- 2	P65A
U 10- 3	U32H
U 10- 4	8FH7
U 10- 5	7C5P
U 10- 6	P65A
U 10- 7	U32H
U 10- 9	0000
U 10-10	8FH7
U 10-11	9H9P
U 10-12	3C8P
U 10-13	9H9P
U 10-14	3C8P
U 10-15	4632
U 15- 1	high
U 15- 2	PPC6
U 15- 3	H9PU
U 15- 4	4243
U 15- 5	8004
U 15- 6	PPC6
U 15- 7	H9PU
U 15-10	4243
U 15-11	8U95
U 15-12	1F3U
U 15-13	8U95
U 15-14	1F3U
U 15-15	7C5P
U 17- 1	high

**Performance Tests and Troubleshooting - Model 64601A**

U 17- 2	PA12	U 37-18	low	U 54-12	8P72
U 17- 3	2135	U 37-19	high	U 54-13	low
U 17- 4	4243	U 37-20	high	U 54-14	8P72
U 17- 5	low	U 37-24	U96C	U 54-15	4555
U 17- 6	low	U 38- 1	0000	U 55- 1	high
U 17- 7	8U95	U 38- 3	4632	U 55- 2	H916
U 17- 9	low	U 38- 4	A38H	U 55- 4	5691
U 17-10	low	U 38- 6	high	U 55- 5	0580
U 17-11	1F30	U 38- 7	low	U 55- 6	low
U 17-12	0002	U 38- 9	high	U 55- 7	low
U 17-13	7C5P	U 38-10	P5U0	U 55- 9	4555
U 17-14	0002	U 38-12	0000	U 55-10	low
U 17-15	low	U 38-13	U96C	U 55-11	U13P
U 34- 6	H19F	U 38-14	0000	U 55-12	3242
U 34- 7	1ACC	U 38-15	high	U 55-13	47A0
U 34- 9	H19F	U 38-17	0000	U 55-14	CAF1
U 34-13	3C8P	U 38-18	low	U 55-15	low
.. .. ..	.....	.. .. ..	.....	.. .. ..	.....

Performance Tests and Troubleshooting - Model 64601A

U 73-11 3532  
U 73-12 PUH8  
U 73-13 3532  
U 73-14 PUH8  
U 73-15 H958  
U 86- 2 5C83  
U 86- 3 0000  
U 86-12 U96C  
U 86-14 U963

# Performance Tests and Troubleshooting - Model 64601A

64601A Timing Control Board  
DISPLAY DRIVER #9

NORM MODE VH = 923F

DATA THRESHOLD HIGH: ttl  
CLOCK THRESHOLD: ttl  
ST-SP-QL THRESHOLD: ttl

Location of ST/SP/START: tp 12 neg. edge  
Location of QUAL/STOP: tp 12 pos. edge  
Location of CLOCK: tp 11 pos. edge  
Location of GROUND: gnd

## TTL

U 56- 1	high	U 58- 8	923F	U 62- 9	P8UF
U 56- 2	high	(TOTLZ=32768)		U 62-10	high
U 56- 3	0C92	U 58-10	F995	U 62-11	P8UF
U 56- 4	U204	U 58-11	5351	U 62-12	4319
U 56- 5	622A	U 58-12	A545	U 62-14	4319
U 56- 6	6731	U 58-13	1A8H	U 62-15	low
U 56- 9	923F	U 58-14	HCHC	U 63- 1	4319
(TOTLZ=0048)		U 58-15	682U	U 63- 3	0000
U 56-10	low	U 58-16	6P3C	(TOTLZ=0FL0)	
U 56-11	23HP	U 58-17	94AF	U 63- 4	H125
U 56-12	F24C	U 59- 1	416C	U 63- 5	4319
U 56-13	C443	U 59- 2	09AP	U 63- 6	H125
U 56-14	1C09	U 59- 3	2U5C	U 63- 8	high
U 56-15	4319	U 59- 4	F19H	U 63- 9	low
U 57- 1	416C	U 59- 5	9UPC	U 63-10	high
U 57- 2	09AP	U 59- 6	2C32	U 63-11	0000
U 57- 3	2U5C	U 59- 7	218A	(TOTLZ=0FL0)	
U 57- 4	F19H	U 59- 8	923F	U 63-12	high
U 57- 5	9UPC	(TOTLZ=32768)		U 63-13	low
U 57- 6	2C32	U 59-10	4FAH	U 76- 1	923F
U 57- 7	39C2	U 59-11	C883	(TOTLZ=32764)	
U 57- 8	923F	U 59-12	A545	U 76- 2	39C2
(TOTLZ=32768)		U 59-13	1A8H	U 76- 3	93P7
U 57-10	2656	U 59-14	HCHC	U 76- 4	2490
U 57-11	93P7	U 59-15	682U	U 76- 5	5351
U 57-12	A545	U 59-16	6P3C	U 76- 6	218A
U 57-13	1A8H	U 59-17	94AF	U 76- 7	C883
U 57-14	HCHC	U 62- 1	low	U 76- 9	AA8F
U 57-15	682U	U 62- 2	923F	U 76-10	2UCH
U 57-16	6P3C	(TOTLZ=65552)		U 76-11	C252
U 57-17	94AF	U 62- 3	low	U 76-12	C078
U 58- 1	416C	U 62- 4	923F	U 76-13	4HCC
U 58- 2	09AP	(TOTLZ=65552)		U 76-14	5C60
U 58- 3	2U5C	U 62- 5	923F	U 76-15	923F
U 58- 4	F19H	(TOTLZ=65552)		(TOTLZ=32764)	
U 58- 5	9UPC	U 62- 6	4319	U 77- 1	F19H
U 58- 6	2C32	U 62- 7	923F	U 77- 2	2U5C
U 58- 7	2490	(TOTLZ=65552)		U 77- 3	09AP

Performance Tests and Troubleshooting - Model 64601A

U 77- 4	416C	U 85- 6	high	U 91-10	923F
U 77- 5	2C32	U 85- 7	C252	(TOTLZ=0048)	
U 77- 6	94AF	U 85- 8	low	U 91-11	923F
U 77- 7	6P3C	U 85- 9	4HCC	(TOTLZ=65552)	
U 77- 8	low	U 85-12	AA8F	U 91-12	high
U 77- 9	4HCC	U 85-14	C883	U 91-13	high
U 77-10	5C60	U 85-15	low	U 91-14	923F
U 77-11	AA8F	U 85-16	5351	(TOTLZ=0040)	
U 77-12	2UCH	U 85-17	low	U 91-15	high
U 77-15	C252	U 85-18	93P7	U 92- 1	high
U 77-16	C078	U 85-19	high	U 92- 2	CCHU
U 77-17	high	U 88- 1	low	U 92- 3	93P7
U 77-18	low	U 88- 2	high	U 92- 4	5351
U 77-19	9925	U 88- 3	0000	U 92- 5	F265
U 77-20	923F	(TOTLZ=99213)		U 92- 6	C883
(TOTLZ=0018)		U 88- 4	0000	U 92- 7	248F
U 77-21	9UPC	(TOTLZ=98537)		U 92- 9	923F
U 77-22	high	U 88- 5	923F	(TOTLZ=0040)	
U 81- 1	low	(TOTLZ=OFLO)		U 92-10	CU28
U 81- 2	low	U 88- 6	0000	U 92-11	AA8F
U 81- 3	5C60	(TOTLZ=99213)		U 92-12	H1CA
U 81- 4	low	U 88- 8	low	U 92-13	4HCC
U 81- 5	low	U 88- 9	high	U 92-14	C252
U 81- 6	C078	U 88-10	low	U 92-15	6CU1
U 81- 7	low	U 88-11	high	U 93- 1	high
U 81- 9	low	U 88-12	high	U 93- 2	82HU
U 81-10	low	U 88-13	low	U 93- 3	0C92
U 81-11	low	U 90- 1	2H31	U 93- 4	U204
U 81-12	low	U 90- 2	A279	U 93- 5	2665
U 81-13	low	U 90- 3	3952	U 93- 6	6731
U 81-14	high	U 90- 4	low	U 93- 7	C48P
U 81-15	low	U 90- 5	high	U 93- 9	923F
U 82- 1	0000	U 90- 6	low	(TOTLZ=0040)	
(TOTLZ=65552)		U 90- 7	9925	U 93-10	UU22
U 82- 2	F24C	U 90- 9	2656	U 93-11	23HP
U 82- 3	923F	U 90-10	F995	U 93-12	H193
(TOTLZ=32768)		U 90-11	4FAH	U 93-13	C443
U 82- 4	0000	U 90-12	high	U 93-14	1C09
(TOTLZ=65552)		U 90-13	0840	U 93-15	6C54
U 82- 5	0000	U 90-14	923F	U 94- 1	high
(TOTLZ=65552)		(TOTLZ=0133)		U 94- 2	923F
U 82- 6	923F	U 90-15	high	(TOTLZ=65552)	
(TOTLZ=65552)		U 91- 1	5A58	U 94- 3	CCHU
U 82- 8	H125	U 91- 2	7UP0	U 94- 4	F265
U 82- 9	high	U 91- 3	0P2F	U 94- 5	248F
U 82-10	4319	U 91- 4	923F	U 94- 6	CU28
U 82-11	high	(TOTLZ=OFLO)		U 94- 7	high
U 82-12	low	U 91- 5	0000	U 94- 9	4319
U 82-13	low	(TOTLZ=99213)		U 94-10	high
U 85- 1	high	U 91- 6	high	U 94-11	F19H
U 85- 2	low	U 91- 7	923F	U 94-12	2U5C
U 85- 3	U204	(TOTLZ=0133)		U 94-13	09AP
U 85- 4	low	U 91- 9	923F	U 94-14	416C
U 85- 5	0C92	(TOTLZ=32764)		U 94-15	HPU4

Performance Tests and Troubleshooting - Model 64601A

U 95- 1 high  
U 95- 2 923F  
(TOTLZ=65552)  
U 95- 3 H1CA  
U 95- 4 6CU1  
U 95- 5 82HU  
U 95- 6 2665  
U 95- 7 high  
U 95- 9 4319  
U 95-10 HPU4  
U 95-11 6P3C  
U 95-12 94AF  
U 95-13 2C32  
U 95-14 9UPC  
U 95-15 P8UF  
U 96- 1 high  
U 96- 2 923F  
(TOTLZ=65552)  
U 96- 3 C48P  
U 96- 4 UU22  
U 96- 5 H193  
U 96- 6 6C54  
U 96- 7 high  
U 96- 9 4319  
U 96-10 P8UF  
U 96-11 A545  
U 96-12 1A8H  
U 96-13 HCHC  
U 96-14 682U  
U 96-15 89HF

# Performance Tests and Troubleshooting - Model 64601A

64601A Timing Control Board  
RATES / INTERVAL A #10

NORM MODE VH = F036

DATA THRESHOLD HIGH: ttl & ecl

CLOCK THRESHOLD: ttl

ST-SP-QL THRESHOLD: ttl

Location of ST/SP/START:	tp 12	neg. edge
Location of QUAL/STOP:	tp 12	pos. edge
Location of CLOCK:	tp 11	pos. edge
Location of GROUND:	gnd	

## TTL

U 28- 1	high	U 86- 7	F036
U 28- 2	4999	U 86-10	U7F0
U 28- 3	H18U	U 86-11	5FA5
U 28- 4	CCU5	U 90- 1	2F7F
U 28- 5	159C	U 90- 2	6914
U 28- 6	3P42	U 90- 3	7466
U 28- 7	6FCU	U 90- 4	low
U 28- 8	4A31	U 90- 5	U7F0
U 28- 9	0HFA	U 90- 6	5FA5
U 28-11	F036	U 90-13	C3A7
U 28-12	AUCF	U 90-14	F036
U 28-13	5P4A	(TOTLZ=0001)	
U 28-14	U1C5	U 90-15	high
U 28-15	3P30	U 91- 1	63C9
U 28-16	3078	U 91- 2	884H
U 28-17	U5PH	U 91- 3	947H
U 28-18	0P0P	U 91- 4	F036
U 28-19	low	(TOTLZ=0207)	
U 49- 4	29C4	U 91- 5	0000
U 49- 5	U7F0	(TOTLZ=0002)	
U 49-12	low	U 91- 6	high
U 49-13	PH4P	U 91- 7	F036
U 85- 1	F036	(TOTLZ=0001)	
U 85- 2	29C4	U 91- 9	high
U 85- 3	0P0P	U 91-10	high
U 85- 4	U7F0	U 91-11	high
U 85- 5	U5PH	U 91-12	F036
U 85- 6	low	U 91-13	F036
U 85- 7	U1C5	U 91-14	high
U 85- 9	5P4A	U 91-15	F036
U 85-12	4A31		
U 85-14	6FCU		
U 85-15	5FA5		
U 85-16	CCU5		
U 85-17	low		
U 85-18	H18U		
U 85-19	F036		
U 86- 5	329A		

## ECL

U 7- 1	high
U 7- 2	49P7
U 7- 3	89H1
U 7- 4	49P7
U 7- 5	89H1
U 7- 6	49P7
U 7- 7	89H1
U 7- 9	49P7
U 7-10	89H1
U 7-12	49P7
U 7-13	89H1
U 7-15	89H1
U 10- 1	high
U 10- 2	64P5
U 10- 3	1F57
U 10- 4	4U8C
U 10- 5	141P
U 10- 6	64P5
U 10- 7	1F57
U 10- 9	0000
U 10-10	4U8C
U 10-11	63P3
U 10-12	U4C8
U 10-13	63P3
U 10-14	U4C8
U 10-15	CP7A
U 11- 1	high
U 11- 2	3AUP
U 11- 3	9H7U
U 11- 4	2AC4
U 11- 5	75UF
U 11- 6	3AUP
U 11- 7	9H7U
U 11- 9	0000
U 11-10	2AC4
U 11-11	C577
U 11-12	9P9H
U 11-13	C577

**Performance Tests and Troubleshooting - Model 64601A**

U 11-14	9P9H	U 37- 4	5UA9	U 55- 4	75UF
U 11-15	2C45	U 37- 6	high	U 55- 6	low
U 13- 1	high	U 37- 7	low	U 55- 7	low
U 13- 2	8H5H	U 37- 8	37AC	U 55- 9	0770
U 13- 3	4H6C	U 37- 9	PH4P	U 55-10	low
U 13- 4	2AC4	U 37-10	U7F0	U 55-11	5UA9
U 13- 5	low	U 37-12	0000	U 55-12	U7F0
U 13- 6	low	U 37-13	37U6	U 55-13	63C5
U 13- 7	C577	U 37-14	0000	U 55-15	low
U 13- 9	low	U 37-15	high	U 67- 1	high
U 13-10	U7F0	U 37-17	0000	U 67- 2	U7F0
U 13-11	9P9H	U 37-18	low	U 67- 3	low
U 13-12	0000	U 37-19	high	U 67- 5	37U6
U 13-13	2C45	U 37-20	high	U 67- 6	C5CC
U 13-14	high	U 37-24	37U6	U 67- 7	37U6
U 13-15	low	U 38- 1	0000	U 67- 9	37U6
U 27- 1	high	U 38- 3	CP7A	U 67-10	U7F0
U 27- 2	high	U 38- 4	F8H1	U 67-11	2C2H
U 27- 4	3AUP	U 38- 6	high	U 67-12	37U6
U 27- 5	low	U 38- 7	low	U 67-13	low
U 27- 7	9H7U	U 38- 9	high	U 67-14	PC1C
U 27- 9	high	U 38-10	9F01	U 71- 1	high
U 27-10	low	U 38-12	0000	U 71- 2	2C2H
U 27-11	C9H3	U 38-13	37U6	U 71- 3	C5CC
U 27-12	C9H3	U 38-14	0000	U 71- 4	1PUC
U 27-13	79P5	U 38-15	high	U 71- 5	1601
U 27-14	79P5	U 38-17	0000	U 71- 6	2C2H
U 27-15	0000	U 38-18	low	U 71- 7	C5CC
U 34- 1	high	U 38-19	high	U 71- 9	0000
U 34-13	U4C8	U 38-20	high	U 71-10	1PUC
U 34-14	348P	U 38-24	37U6	U 71-11	0U7H
U 34-15	F036	U 42- 1	high	U 71-12	63C5
U 35- 1	high	U 42- 2	F036	U 71-13	0U7H
U 35- 2	C9H3	U 42- 4	high	U 71-14	63C5
U 35- 4	348P	U 42- 6	3AUP	U 71-15	75UF
U 35- 5	8H5H	U 49- 7	U7F0	U 73- 1	high
U 35- 6	4H6C	U 49-11	low	U 73- 2	PFC7
U 35- 7	U4C8	U 49-15	PH4P	U 73- 3	1250
U 36- 1	0000	U 54- 1	high	U 73- 4	A905
U 36- 3	9FF8	U 54- 2	F746	U 73- 5	329A
U 36- 6	high	U 54- 3	F746	U 73- 6	PFC7
U 36- 7	low	U 54- 4	9F01	U 73- 7	1250
U 36- 9	49P7	U 54- 5	10A4	U 73- 9	0000
U 36-12	0000	U 54- 6	6F59	U 73-10	A905
U 36-13	37U6	U 54- 7	6C58	U 73-11	10A4
U 36-14	0000	U 54- 9	37U6	U 73-12	6F59
U 36-15	high	U 54-10	5667	U 73-13	10A4
U 36-17	0000	U 54-11	1601	U 73-14	6F59
U 36-18	low	U 54-12	F746	U 73-15	1601
U 36-19	high	U 54-13	low	U 86- 2	329A
U 36-20	high	U 54-14	F746	U 86- 3	0000
U 36-24	37U6	U 54-15	0770	U 86-12	37U6
U 37- 1	0000	U 55- 1	high	U 86-13	F036
U 37- 3	F8H1	U 55- 2	PH4P		

# Performance Tests and Troubleshooting - Model 64601A

64601A Timing Control Board  
LESS THAN INTERVAL A # 11

NORM MODE VH = 593A

DATA THRESHOLD HIGH: ttl & ecl

CLOCK THRESHOLD: ttl

ST-SP-QL THRESHOLD: ttl

Location of ST/SP/START: tp 12	neg. edge
Location of QUAL/STOP: tp 12	pos. edge
Location of CLOCK: tp 11	pos. edge
Location of GROUND: gnd	

## TTL

U 28- 1	high	U 32- 5	4.98 DCV	U 90- 6	P5AF
U 28- 2	low	U 32- 6	0.17 DCV	U 90-14	593A
U 28- 3	A9A8	U 32- 7	0.01 DCV	U 90-15	high
U 28- 4	C197	U 32- 8	4.98 DCV	U 91- 1	0583
U 28- 5	low	U 32- 9	0.16 DCV	U 91- 2	CU50
U 28- 6	low	U 32-10	0.01 DCV	U 91- 3	05C0
U 28- 7	H780	U 32-11	4.98 DCV	U 91- 4	593A
U 28- 8	7020	U 32-12	0.91 DCV	(TOTLZ=0207)	
U 28- 9	low	U 32-13	0.01 DCV	U 91- 5	0000
U 28-11	593A	U 32-14	0.03 DCV	(TOTLZ=0002)	
U 28-12	high	U 49- 4	U7F2	U 91- 6	high
U 28-13	H6H5	U 49- 5	P7A2	U 91- 7	593A
U 28-14	FPA8	U 49-12	low	(TOTLZ=0001)	
U 28-15	low	U 49-13	F8C7	U 91-12	593A
U 28-16	high	U 85- 1	593A	U 91-13	593A
U 28-17	A9A6	U 85- 2	U7F2	U 91-15	593A
U 28-18	822P	U 85- 3	822P		
U 28-19	low	U 85- 4	P7A2		
U 31- 1	-4.53 DCV	U 85- 5	A9A6		
U 31- 2	-5.17 DCV	U 85- 6	9226		
U 31- 3	-5.1 DCV	U 85- 7	FPA8		
U 31- 4	-5.17 DCV	U 85- 9	H6H5		
U 31- 5	-4.37 DCV	U 85-12	7020		
U 31- 6	-4.94 DCV	U 85-14	H780		
U 31- 7	-5.17 DCV	U 85-15	P5AF		
U 31- 8	-5.17 DCV	U 85-16	C197		
U 31- 9	-0.83 DCV	U 85-17	low		
U 31-10	0.16 DCV	U 85-18	A9A8		
U 31-11	0.01 DCV	U 85-19	593A		
U 31-12	-5.17 DCV	U 86- 5	AAC3		
U 31-13	0.64 DCV	U 86- 7	593A		
U 31-14	0.01 DCV	U 86-10	9266		
U 31-15	-4.37 DCV	U 86-11	P5AF		
U 31-16	-4.52 DCV	U 90- 1	74F9		
U 32- 1	4.98 DCV	U 90- 2	06HC		
U 32- 2	0.17 DCV	U 90- 3	292H		
U 32- 3	0.01 DCV	U 90- 4	low		
U 32- 4	0.17 DCV	U 90- 5	9266		

**Performance Tests and Troubleshooting - Model 64601A**

ECL						
U 10- 1	high	U 27-14	207H	U 38-24	FC5F	
U 10- 2	HC17	U 27-15	0000	U 42- 1	high	
U 10- 3	C223	U 34- 1	high	U 42- 2	593A	
U 10- 4	H911	U 34- 2	7P7F	U 42- 4	593A	
U 10- 5	5H61	U 34- 6	0915	U 42- 5	AC7U	
U 10- 6	HC17	U 34-13	16P4	U 42- 6	2A42	
U 10- 7	C223	U 34-14	4UHP	U 49- 7	P7A2	
U 10- 9	0000	U 36- 1	0000	U 49-11	low	
U 10-10	H911	U 36- 3	A5AF	U 49-15	F8C7	
U 10-11	F687	U 36- 6	high	U 54- 1	high	
U 10-12	16P4	U 36- 7	low	U 54- 2	P8HH	
U 10-13	F687	U 36- 9	P7A2	U 54- 3	P8HH	
U 10-14	16P4	U 36-12	0000	U 54- 4	2U82	
U 10-15	H4HA	U 36-13	FC5F	U 54- 5	1PUP	
U 11- 1	high	U 36-14	0000	U 54- 6	2570	
U 11- 2	2A42	U 36-15	high	U 54- 7	P073	
U 11- 3	FA89	U 36-17	0000	U 54- 9	FC5F	
U 11- 4	4U4C	U 36-18	low	U 54-10	1242	
U 11- 5	009A	U 36-19	high	U 54-11	P71U	
U 11- 6	2A42	U 36-20	high	U 54-12	P8HH	
U 11- 7	FA89	U 36-24	FC5F	U 54-13	low	
U 11- 9	0000	U 37- 1	0000	U 54-14	P8HH	
U 11-10	4U4C	U 37- 3	1H36	U 54-15	C1P7	
U 11-11	H202	U 37- 4	HPU6	U 55- 1	high	
U 11-12	36A9	U 37- 6	high	U 55- 2	F8C7	
U 11-13	H202	U 37- 7	low	U 55- 4	009A	
		U 37- 9	F8C7	U 55- 5	3U34	
		U 37-10	0000	U 55- 6	1uu	

Performance Tests and Troubleshooting - Model 64601A

U 71- 5 P71U  
U 71- 6 8628  
U 71- 7 36C3  
U 71- 9 0000  
U 71-10 PPUP  
U 71-11 28H7  
U 71-12 CP64  
U 71-13 28H7  
U 71-14 CP64  
U 71-15 009A  
U 73- 1 high  
U 73- 2 8830  
U 73- 3 PP17  
U 73- 4 82AF  
U 73- 5 AAC3  
U 73- 6 8830  
U 73- 7 PP17  
U 73- 9 0000  
U 73-10 82AF  
U 73-11 1PUP  
U 73-12 2570  
U 73-13 1PUP  
U 73-14 2570  
U 73-15 P71U  
U 86- 2 AAC3  
U 86- 3 0000  
U 86-12 FC5F  
U 86-14 FC1F

64601A Timing Control Board  
TRANSITION TRIGGER A #12

NORM MODE

VH = FC27

DATA THRESHOLD HIGH: ttl & ecl  
CLOCK THRESHOLD: ttl  
ST-SP-QL THRESHOLD: ttlLocation of ST/SP/START: tp 12 neg. edge  
Location of QUAL/STOP: tp 12 pos. edge  
Location of CLOCK: tp 11 pos. edge  
Location of GROUND: gnd

## TTL

U 49- 4	71P4	U 91- 5	0000
U 49- 5	3242	(TOTLZ=0002)	
U 49-12	low	U 91- 6	high
U 49-13	H916	U 91- 7	FC27
U 85- 1	FC27	(TOTLZ=0001)	
U 85- 2	71P4	U 91- 9	high
U 85- 3	CU8A	U 91-10	high
U 85- 4	3242	U 91-11	high
U 85- 5	FAAC	U 91-12	FC27
U 85- 6	3244	U 91-13	FC27
U 85- 7	86PC	U 91-14	high
U 85- 9	2H80	U 91-15	FC27
U 85-12	0P04		
U 85-14	HAU0		
U 85-15	7FC5		
U 85-16	1632		
U 85-17	low		
U 85-18	5535		
U 85-19	FC27		
U 86- 5	54UF		
U 86- 7	FC27		
U 86-10	324F		
U 86-11	7FC5		
U 90- 1	4P99		
U 90- 2	F0HA		
U 90- 3	4524		
U 90- 4	low		
U 90- 5	324F		
U 90- 6	7FC5		
U 90-13	FAA7		
U 90-14	FC27		
(TOTLZ=0001)			
U 90-15	high		
U 91- 1	A0C0		
U 91- 2	C7PA		
U 91- 3	A0C7		
U 91- 4	FC27		
(TOTLZ=0207)			

## ECL

U 7- 1	high
U 7- 2	3242
U 7- 3	U965
U 7- 4	3242
U 7- 5	U965
U 7- 6	3242
U 7- 7	U965
U 7- 9	3242
U 7-10	U965
U 7-12	3242
U 7-13	U965
U 7-15	U965
U 10- 1	high
U 10- 2	F50C
U 10- 3	P285
U 10- 4	8403
U 10- 5	3HUF
U 10- 6	F50C
U 10- 7	P285
U 10- 9	0000
U 10-10	8403
U 10-11	19U4
U 10-12	79CC
U 10-13	19U4
U 10-14	79CC
U 10-15	6728
U 11- 1	high
U 11- 2	9433
U 11- 3	P4AH
U 11- 4	HFP2
U 11- 5	F2PS
U 11- 6	9433
U 11- 7	P4AH
U 11- 9	0000
U 11-10	HFP2
U 11-11	F0F5
U 11-12	CC97
U 11-13	F0F5

Performance Tests and Troubleshooting - Model 64601A

U 11-14 CC9Y	U 36-19 high	U 54-10 U709
U 11-15 288A	U 36-20 high	U 54-11 F165
U 13- 1 high	U 36-24 U96C	U 54-12 F6F3
U 13- 2 9905	U 37- 1 0000	U 54-13 low
U 13- 3 5222	U 37- 3 10CA	U 54-14 F6F3
U 13- 4 HFP2	U 37- 4 28FH	U 54-15 0HP4
U 13- 5 low	U 37- 6 high	U 55- 1 high
U 13- 6 low	U 37- 7 low	U 55- 2 H916
U 13- 7 F0F5	U 37- 8 9P4H	U 55- 4 F2P5
U 13- 9 low	U 37- 9 H916	U 55- 5 FU52
U 13-10 low	U 37-10 0000	U 55- 6 low
U 13-11 CC97	U 37-12 0000	U 55- 7 low
U 13-12 0002	U 37-13 U96C	U 55- 9 0HP4
U 13-13 288A	U 37-14 0000	U 55-10 low
U 13-14 high	U 37-15 high	U 55-11 28FH
U 13-15 low	U 37-17 0000	U 55-12 3242
U 27- 1 high	U 37-18 low	U 55-13 3220
U 27- 2 high	U 37-19 high	U 55-14 768C
U 27- 3 58C6	U 37-20 high	U 55-15 low
U 27- 4 9433	U 37-24 U96C	U 67- 1 high
U 27- 5 low	U 38- 1 0000	U 67- 2 low
U 27- 6 P0CP	U 38- 3 6728	U 67- 3 low
U 27- 7 P4AH	U 38- 4 10CA	U 67- 4 CHAF
U 27- 9 high	U 38- 6 high	U 67- 5 U96C
U 27-10 low	U 38- 7 low	U 67- 6 09C7
U 27-11 2C99	U 38- 9 high	U 67- 7 U965
U 27-12 2C99	U 38-10 P5U0	U 67- 9 U96C
U 27-13 P0CP	U 38-12 0000	U 67-10 3242
U 27-14 P0CP	U 38-13 U96C	U 67-11 4P06
U 34- 1 high	U 38-14 0000	U 67-12 U96C
U 34- 2 P0CP	U 38-15 high	U 67-13 low
U 34- 3 2C99	U 38-17 0000	U 67-14 8521
U 34- 4 P0CP	U 38-18 low	U 67-15 high
U 34-13 79CC	U 38-19 high	U 71- 1 high
U 34-14 C29F	U 38-20 high	U 71- 2 4P06
U 35- 1 high	U 38-24 U96C	U 71- 3 09C7
U 35- 2 2C99	U 42- 1 high	U 71- 4 AA6U
U 35- 3 P0CP	U 42- 2 high	U 71- 5 F165
U 35- 4 C29F	U 42- 3 FU52	U 71- 6 4P06
U 35- 5 9905	U 42- 4 FC27	U 71- 7 09C7
U 35- 6 5222	U 42- 5 58C6	U 71- 9 0000
U 35- 7 79CC	U 42- 6 9433	U 71-10 AA6U
U 36- 1 0000	U 42- 7 P0CP	U 71-11 8PF2
U 36- 3 PC82	U 49- 7 3242	U 71-12 3220
U 36- 4 71P4	U 49-11 low	U 71-13 8PF2
U 36- 6 high	U 49-15 H916	U 71-14 3220
U 36- 7 low	U 54- 1 high	U 71-15 F2P5
U 36- 9 3242	U 54- 2 F6F3	U 73- 1 high
U 36-12 0000	U 54- 3 F6F3	U 73- 2 21H3
U 36-13 U96C	U 54- 4 P5U0	U 73- 3 65A8
U 36-14 0000	U 54- 5 55F5	U 73- 4 1F60
U 36-15 high	U 54- 6 HUA3	U 73- 5 54UF
U 36-17 0000	U 54- 7 H7H6	U 73- 6 21H3
U 36-18 low	U 54- 9 U96C	U 73- 7 65A8

Performance Tests and Troubleshooting - Model 64601A

U 73- 9	0000
U 73-10	1F60
U 73-11	55FS
U 73-12	HUA3
U 73-13	55FS
U 73-14	HUA3
U 73-15	F165
U 86- 2	54UF
U 86- 3	0000
U 86-12	U96C
U 86-14	U963

# Performance Tests and Troubleshooting - Model 64601A

64601A Timing Control Board  
AND #13

NORM MODE

VH = 60AU

DATA THRESHOLD HIGH: ttl & ecl

CLOCK THRESHOLD: ttl

ST-SP-QL THRESHOLD: ttl

Location of ST/SP/START: tp 12	neg. edge
Location of QUAL/STOP: tp 12	pos. edge
Location of CLOCK: tp 11	pos. edge
Location of GROUND: and tp 7	

TTL	ECL	
U 49- 4 H830	U 10- 1 high	U 13-10 low
U 49- 5 894F	U 10- 2 622H	U 13-11 HHU9
U 49-12 low	U 10- 3 1696	U 13-12 4764
U 49-13 HF59	U 10- 4 8C4C	U 13-13 PPUF
U 64- 4 low	U 10- 5 2AAA	U 13-14 1HP7
U 64- 5 P0H1	U 10- 6 622H	U 13-15 low
U 64-12 PU50	U 10- 7 1696	U 15- 1 high
U 64-13 low	U 10- 9 0000	U 15- 2 777P
U 85- 1 60AU	(TOTLZ=0130)	U 15- 3 3CCU
(TOTLZ=0004)	U 10-10 8C4C	U 15- 4 6AA7
U 85- 2 H830	U 10-11 32HH	U 15- 5 PPUF
U 85- 3 H4CU	U 10-12 4996	U 15- 6 777P
U 85- 4 894F	U 10-13 32HH	U 15- 7 3CCU
U 85- 5 6H5P	U 10-14 4996	U 15- 9 0000
U 85- 6 low	U 10-15 834C	(TOTLZ=0130)
U 85- 7 6HF7	U 11- 1 high	U 15-10 6AA7
U 85- 8 low	U 11- 2 UHCP	U 15-11 P5AC
U 85- 9 55P2	U 11- 3 7PHU	U 15-12 5555
U 85-11 PU50	U 11- 4 4817	U 15-13 P5AC
U 85-12 2H1C	U 11- 5 UC7H	U 15-14 5555
U 85-13 P0H1	U 11- 6 UHCP	U 15-15 2AAA
U 85-14 HU32	U 11- 7 7PHU	U 17- 1 high
U 85-15 6390	U 11- 9 0000	U 17- 2 8AF9
U 85-16 1278	(TOTLZ=0130)	U 17- 3 PA66
U 85-17 low	U 11-10 4817	U 17- 4 6AA7
U 85-18 05C6	U 11-11 U4U3	U 17- 5 low
U 85-19 60AU	U 11-12 HHU9	U 17- 6 low
(TOTLZ=0004)	U 11-13 U4U3	U 17- 7 P5AC
	U 11-14 HHU9	U 17- 9 low
	U 11-15 PPUF	U 17-10 low
	U 13- 1 high	U 17-11 5555
	U 13- 2 U781	U 17-12 4764
	U 13- 3 972P	U 17-13 2AAA
	U 13- 4 4817	U 17-14 1HP7
	U 13- 5 low	U 17-15 low
	U 13- 6 low	U 34- 1 high
	U 13- 7 U4U3	U 34- 2 CP17
	U 13- 9 low	U 34- 3 HPC8

Performance Tests and Troubleshooting - Model 64601A

U 34- 4	CP17		U 64-15	low
U 34- 6	F35U		U 71- 1	high
U 34- 7	A3U0		U 71- 2	C1C7
U 34- 9	F35U		U 71- 3	8823
U 34-13	4996		U 71- 4	94P9
U 34-14	2939		U 71- 5	F29U
U 34-15	high		U 71- 6	C1C7
U 35- 1	high		U 71- 7	8823
U 35- 2	HPC8		U 71- 9	0000
U 35- 3	CP17	(TOTLZ=0130)		
U 35- 4	2939		U 71-10	94P9
U 35- 5	U781		U 71-11	PHU4
U 35- 6	972P		U 71-12	U6UA
U 35- 7	4996		U 71-13	PHU4
U 35- 9	low		U 71-14	U6UA
U 35-10	2939		U 71-15	UC7H
U 35-11	8AF9		U 73- 1	high
U 35-12	PA66		U 73- 2	AA7A
U 35-13	4996		U 73- 3	A245
U 35-14	F35U		U 73- 4	01HA
U 35-15	A3U0		U 73- 5	H0C7
U 49- 7	894F		U 73- 6	AA7A
U 49-11	low		U 73- 7	A245
U 49-15	HF59		U 73- 9	0000
U 54- 1	high	(TOTLZ=0130)		
U 54- 2	C1FU		U 73-10	01HA
U 54- 3	C1FU		U 73-11	A76H
U 54- 4	U498		U 73-12	24FP
U 54- 5	A76H		U 73-13	A76H
U 54- 6	24FP		U 73-14	24FP
U 54- 7	UUPC		U 73-15	F29U
U 54- 9	8622			
U 54-10	6476			
U 54-11	F29U			
U 54-12	C1FU			
U 54-13	low			
U 54-14	C1FU			
U 54-15	H160			
U 55- 1	high			
U 55- 2	HF59			
U 55- 3	CC05			
U 55- 4	UC7H			
U 55- 5	A3CU			
U 55- 6	low			
U 55- 7	low			
U 55- 9	H160			
U 55-10	low			
U 55-11	C5F8			
U 55-12	894F			
U 55-13	U6UA			
U 55-14	CU90			
U 55-15	low			
U 64- 7	P0H1			
U 64-11	PU50			

Performance Tests and Troubleshooting - Model 64601A

64601A Timing Control Board  
OR #14

NORM MODE

VH = 60AU

DATA THRESHOLD HIGH: ttl & ecl

CLOCK THRESHOLD: ttl

ST-SP-QL THRESHOLD: ttl

Location of ST/SP/START: tp 12 neg. edge  
 Location of QUAL/STOP: tp 12 pos. edge  
 Location of CLOCK: tp 11 pos. edge  
 Location of GROUND: gnd

TTL	ECL	
U 49- 4 179F	U 10- 1 high	U 13-10 low
U 49- 5 P6PC	U 10- 2 3542	U 13-11 C2C1
U 49-12 low	U 10- 3 CH21	U 13-12 2F99
U 49-13 6F62	U 10- 4 5P90	U 13-13 5958
U 64- 4 low	U 10- 5 8474	U 13-14 7551
U 64- 5 A056	U 10- 6 3542	U 13-15 low
U 64-12 3UU6	U 10- 7 CH21	U 15- 1 high
U 64-13 low	U 10- 9 0000	U 15- 2 AFAF
U 85- 1 60AU	(TOTLZ=0130)	U 15- 3 H656
(TOTLZ=0004)	U 10-10 5P90	U 15- 4 1F53
U 85- 2 179F	U 10-11 H830	U 15- 5 5958
U 85- 3 H4CU	U 10-12 FC98	U 15- 6 AFAF
U 85- 4 P6PC	U 10-13 H830	U 15- 7 H656
U 85- 5 6H5P	U 10-14 FC98	U 15- 9 0000
U 85- 6 low	U 10-15 65FF	(TOTLZ=0130)
U 85- 7 6HF7	U 11- 1 high	U 15-10 1F53
U 85- 8 low	U 11- 2 0934	U 15-11 5PH1
U 85- 9 55P2	U 11- 3 049A	U 15-12 08P8
U 85-11 3UU6	U 11- 4 U535	U 15-13 5PH1
U 85-12 2H1C	U 11- 5 1268	U 15-14 08P8
U 85-13 A056	U 11- 6 0934	U 15-15 8474
U 85-14 HU32	U 11- 7 049A	U 17- 1 high
U 85-15 6390	U 11- 9 0000	U 17- 2 614H
U 85-16 1278	(TOTLZ=0130)	U 17- 3 01P2
U 85-17 low	U 11-10 U535	U 17- 4 1F53
U 85-18 05C6	U 11-11 2A62	U 17- 5 low
U 85-19 60AU	U 11-12 C2C1	U 17- 6 low
(TOTLZ=0004)	U 11-13 2A62	U 17- 7 5PH1
	U 11-14 C2C1	U 17- 9 low
	U 11-15 5958	U 17-10 low
	U 13- 1 high	U 17-11 08P8
	U 13- 2 2607	U 17-12 2F99
	U 13- 3 46A8	U 17-13 8474
	U 13- 4 U535	U 17-14 7551
	U 13- 5 low	U 17-15 low
	U 13- 6 low	U 34- 1 high
	U 13- 7 2A62	U 34- 2 PH9U
	U 13- 9 low	U 34- 3 8H30

## Performance Tests and Troubleshooting - Model 64601A

U 34- 4	PH9U	U 71- 2	930F
U 34- 6	AAH5	U 71- 3	197P
U 34- 7	FA7A	U 71- 4	HF47
U 34- 9	AAH5	U 71- 5	87P9
U 34-13	FC98	U 71- 6	930F
U 34-14	AC37	U 71- 7	197P
U 35- 1	high	U 71- 9	0000
U 35- 2	8H30	(TOTLZ=0130)	
U 35- 3	PH9U	U 71-10	HF47
U 35- 4	AC37	U 71-11	49A3
U 35- 5	2607	U 71-12	24H1
U 35- 6	46A8	U 71-13	49A3
U 35- 7	FC98	U 71-14	24H1
U 35- 9	low	U 71-15	1268
U 35-10	AC37	U 73- 1	high
U 35-11	614H	U 73- 2	04C2
U 35-12	01P2	U 73- 3	U521
U 35-13	FC98	U 73- 4	2A68
U 35-14	AAH5	U 73- 5	8H26
U 35-15	FA7A	U 73- 6	04C2
U 49- 7	P6PC	U 73- 7	U521
U 49-11	low	U 73- 9	0000
U 49-15	6F62	(TOTLZ=0130)	
U 54- 1	high	U 73-10	2A68
U 54- 2	C1FU	U 73-11	C2C4
U 54- 3	C1FU	U 73-12	AP22
U 54- 4	07HC	U 73-13	C2C4
U 54- 5	C2C4	U 73-14	AP22
U 54- 6	AP22	U 73-15	87P9
U 54- 7	5CCF		
U 54- 9	8622		
U 54-10	46FH		
U 54-11	87P9		
U 54-12	C1FU		
U 54-13	low		
U 54-14	C1FU		
U 54-15	H160		
U 55- 1	high		
U 55- 2	6F62		
U 55- 4	1268		
U 55- 5	8C70		
U 55- 6	low		
U 55- 7	low		
U 55- 9	H160		
U 55-10	low		
U 55-11	5938		
U 55-12	P6PC		
U 55-13	24H1		
U 55-14	0HF8		
U 55-15	low		
U 64- 7	A056		
U 64-11	3UU6		
U 64-15	low		
U 71- 1	high		

Performance Tests and Troubleshooting - Model 64601A

64601A Timing Control Board  
B FOLLOWED BY A # 15

NORM MODE

VH = F150

DATA THRESHOLD HIGH: ttl & ecl

CLOCK THRESHOLD: ttl

ST-SP-QL THRESHOLD: ttl

Location of ST/SP/START: tp 12 neg. edge  
 Location of QUAL/STOP: tp 12 pos. edge  
 Location of CLOCK: tp 11 pos. edge  
 Location of GROUND: gnd

TTL	ECL	
U 49- 4 AC98	U 10- 1 high	U 13-10 low
U 49- 5 1888	U 10- 2 13H7	U 13-11 H0U1
U 49-12 low	U 10- 3 F6PA	U 13-13 2779
U 49-13 1888	U 10- 4 6375	U 13-14 35HS
U 64- 4 low	U 10- 5 644P	U 13-15 low
U 64- 5 743F	U 10- 6 13H7	U 15- 1 high
U 64-12 CHF6	U 10- 7 F6PA	U 15- 2 13CF
U 64-13 low	U 10- 9 0000	U 15- 3 89HP
U 85- 1 F150	(TOTLZ=0130)	U 15- 4 2A1P
(TOTLZ=0005)	U 10-10 6375	U 15- 5 2779
U 85- 2 AC98	U 10-11 HU4C	U 15- 6 13CF
U 85- 3 23H2	U 10-12 FP55	U 15- 7 89HP
U 85- 4 1888	U 10-13 HU4C	U 15- 9 0000
U 85- 5 F413	U 10-14 FP55	(TOTLZ=0130)
U 85- 6 low	U 10-15 A82C	U 15-10 2A1P
U 85- 7 48P7	U 11- 1 high	U 15-11 C4UU
U 85- 8 low	U 11- 2 A451	U 15-12 157P
U 85- 9 7150	U 11- 3 H228	U 15-13 C4UU
U 85-11 CHF6	U 11- 4 87PS	U 15-14 157P
U 85-12 CC9C	U 11- 5 48A2	U 15-15 644P
U 85-13 743F	U 11- 6 A451	U 17- 1 high
U 85-14 1453	U 11- 7 H228	U 17- 2 A5PC
U 85-15 F721	U 11- 9 0000	U 17- 3 64C4
U 85-16 67C5	(TOTLZ=0130)	U 17- 4 2A1P
U 85-17 low	U 11-10 87PS	U 17- 5 low
U 85-18 338A	U 11-11 P202	U 17- 6 low
U 85-19 F150	U 11-12 H0U1	U 17- 7 C4UU
(TOTLZ=0005)	U 11-13 P202	U 17- 9 low
	U 11-14 H0U1	U 17-10 low
	U 11-15 2779	U 17-11 157P
	U 13- 1 high	U 17-13 644P
	U 13- 2 P118	U 17-14 35HS
	U 13- 3 2047	U 17-15 low
	U 13- 4 87PS	U 42- 1 high
	U 13- 5 low	U 42- 3 C7P0
	U 13- 6 low	U 42- 4 high
	U 13- 7 P202	U 42- 5 F1PA
	U 13- 9 low	U 42- 6 A451

Performance Tests and Troubleshooting - Model 64601A

U 42- 7	2U4H	U 69- 3	0000
U 42- 9	low	(TOTLZ=0130)	
U 42-10	high	U 69- 4	5949
U 42-11	73FH	U 69- 5	low
U 42-12	13CF	U 69- 6	0000
U 42-13	60CP	(TOTLZ=0170)	
U 42-14	F102	U 69- 7	8P42
U 42-15	005H	U 69- 9	3240
U 54- 1	high	U 69-10	8P42
U 54- 2	C036	U 69-11	8P42
U 54- 3	C036	U 69-12	U31U
U 54- 4	4H2A	U 69-13	high
U 54- 5	6U6F	U 69-14	U31U
U 54- 6	5947	U 71- 1	high
U 54- 7	9P91	U 71- 2	A759
U 54- 9	8P42	U 71- 3	725F
U 54-10	F82C	U 71- 4	18HP
U 54-11	0H53	U 71- 5	0H53
U 54-12	C036	U 71- 6	A759
U 54-13	low	U 71- 7	725F
U 54-14	C036	U 71- 9	0000
U 54-15	7169	(TOTLZ=0130)	
U 55- 1	high	U 71-10	18HP
U 55- 2	1888	U 71-11	F36P
U 55- 4	48A2	U 71-12	0U46
U 55- 5	C7P0	U 71-13	F36P
U 55- 6	low	U 71-14	0U46
U 55- 7	low	U 71-15	48A2
U 55- 9	7169	U 73- 1	high
U 55-10	low	U 73- 2	5949
U 55-11	509P	U 73- 3	F255
U 55-12	80CP	U 73- 4	40HA
U 55-13	0U46	U 73- 5	546U
U 55-14	F102	U 73- 6	5949
U 55-15	low	U 73- 7	F255
U 64- 7	743F	U 73- 9	0000
U 64-11	CHF6	(TOTLZ=0130)	
U 64-15	low	U 73-10	40HA
U 67- 1	high	U 73-11	6U6F
U 67- 2	H882	U 73-12	5947
U 67- 3	low	U 73-13	6U6F
U 67- 4	005H	U 73-14	5947
U 67- 5	8P42	U 73-15	0H53
U 67- 6	725F	U 74- 1	high
U 67- 7	H9H7	U 74- 2	80CP
U 67- 9	8P42	U 74- 4	8P42
U 67-10	1888	U 74- 5	H882
U 67-11	A759	U 74-10	5949
U 67-12	8P42	U 74-11	6606
U 67-13	low	U 74-12	low
U 67-14	6606	U 74-13	8P42
U 67-15	high	U 74-14	high
U 69- 1	high		
U 69- 2	low		

Performance Tests and Troubleshooting - Model 64601A

64601A Timing Control Board  
DISPLAY TEST- 1ST PATTERN

QUAL MODE

VH = 383A

Qual = high

DATA THRESHOLD: ttl

CLOCK THRESHOLD: ttl

ST-SP-QL THRESHOLD: ttl

Location of ST/SP/START: tp 10 pos. edge

Location of QUAL/STOP: U99-12 or U 81-13 pos. edge

Location of CLOCK: tp 8 pos. edge

Location of GROUND: gnd

TTL

U 56- 1	high	U 58-16	5AFC	U 61- 4	high
U 56- 2	low	U 58-17	5632	U 61- 5	383A
U 56- 5	high	U 59- 1	P816	(TOTLZ=0025)	
U 56- 7	high	U 59- 2	580H	U 61- 6	0000
U 56- 9	high	U 59- 3	12A9	(TOTLZ=0024)	
U 56-10	high	U 59- 4	UPF6	U 61- 9	383A
U 56-12	low	U 59- 5	8779	(TOTLZ=0001)	
U 56-15	high	U 59- 6	82PU	U 61-10	high
U 57- 1	P816	U 59- 7	2A93	U 61-11	CC34
U 57- 2	580H	U 59- 8	high	U 61-12	CC34
U 57- 3	12A9	U 59-10	low	U 61-13	383A
U 57- 4	UPF6	U 59-12	4CP2	(TOTLZ=0024)	
U 57- 5	8779	U 59-13	HU2A	U 61-14	383A
U 57- 6	82PU	U 59-14	4521	U 61-15	383A
U 57- 7	H02F	U 59-15	986C	(TOTLZ=0024)	
U 57- 8	high	U 59-16	5AFC	U 62- 1	high
U 57-10	low	U 59-17	5632	U 62- 2	high
U 57-12	4CP2	U 60- 1	low	U 62- 3	0000
U 57-13	HU2A	U 60- 2	P816	(TOTLZ=12519)	
U 57-14	4521	U 60- 3	H02F	U 62- 4	0000
U 57-15	986C	U 60- 4	6037	(TOTLZ=12519)	
U 57-16	5AFC	U 60- 5	C01C	U 62- 5	0000
U 57-17	5632	U 60- 6	9549	(TOTLZ=12519)	
U 58- 1	P816	U 60- 7	2A93	U 62- 6	383A
U 58- 2	580H	U 60- 8	9549	(TOTLZ=0024)	
U 58- 3	12A9	U 60- 9	4AA4	U 62- 7	383A
U 58- 4	UPF6	U 60-11	0000	(TOTLZ=0024)	
U 58- 5	8779	(TOTLZ=12519)		U 62- 9	U352
U 58- 6	82PU	U 60-12	H02F	U 62-10	U352
U 58- 7	6037	U 60-13	P816	U 62-11	1166
U 58- 8	high	U 60-14	C01C	U 62-12	383A
U 58-10	low	U 60-15	580H	(TOTLZ=0001)	
U 58-12	4CP2	U 60-16	637P	U 62-13	383A
U 58-13	HU2A	U 60-17	F6UF	U 62-14	high
U 58-14	4521	U 60-19	high	U 62-15	low
U 58-15	986C	U 61- 1	383A	U 63- 1	high
		U 61- 2	1166	U 63- 2	383A
		U 61- 3	1166	(TOTLZ=0024)	

**Performance Tests and Troubleshooting - Model 64601A**

U 63- 4	high	U 78-15	U352	U 82-11	low
U 63- 5	383A	U 79- 1	low	U 82-12	high
(TOTLZ=0024)		U 79- 2	high	U 82-13	high
U 63- 6	0000	U 79- 3	986C	U 83- 1	637P
(TOTLZ=0024)		U 79- 4	AHAU	U 83- 2	A1FH
U 63- 8	383A	U 79- 5	AU73	U 83- 3	383A
(TOTLZ=12518)		U 79- 6	CU1A	(TOTLZ=12518)	
U 63- 9	0000	U 79- 7	9023	U 83- 4	0000
(TOTLZ=12519)		U 79- 9	0U22	(TOTLZ=12519)	
U 63-10	high	U 79-10	9286	U 83- 5	993F
U 63-12	383A	U 79-11	7923	U 83- 6	99U7
(TOTLZ=12518)		U 79-12	PH28	U 83- 8	883F
U 63-13	high	U 79-13	low	U 83- 9	8556
U 76- 1	high	U 79-14	low	U 83-10	14AP
U 76- 2	H02F	U 79-15	low	U 83-13	14AP
U 76- 4	6037	U 80- 1	580H	U 84- 1	high
U 76- 6	2A93	U 80- 2	C01C	U 84- 2	0000
U 76-10	F6UF	U 80- 3	H02F	U 84- 3	383A
U 76-12	CAH5	U 80- 4	P816	(TOTLZ=0024)	
U 76-14	CU43	U 80- 5	PH28	U 84- 4	high
U 76-15	high	U 80- 6	7923	U 84- 5	0000
U 77- 1	UPF6	U 80- 7	9286	U 84- 6	383A
U 77- 2	12A9	U 80- 9	CH6F	U 84- 8	low
U 77- 3	580H	U 80-10	8556	U 84- 9	high
U 77- 4	P816	U 80-11	A900	U 84-10	high
U 77- 5	82PU	U 80-12	842U	U 84-11	0000
U 77- 6	5632	U 80-13	low	U 84-12	high
U 77- 7	5AFC	U 80-14	low	U 84-13	high
U 77- 8	low	U 80-15	low	U 88- 1	low
U 77-10	CU43	U 81- 1	high	U 88- 2	high
U 77-12	F6UF	U 81- 2	HUA1	U 88- 4	low
U 77-13	high	U 81- 3	CU43	U 88- 8	C383
U 77-14	high	U 81- 4	HUA1	U 88- 9	99U7
U 77-16	CAH5	U 81- 5	6UH0	U 88-10	FF2A
U 77-17	high	U 81- 6	CAH5	U 88-11	low
U 77-18	low	U 81- 7	5H6A	U 88-12	U352
U 77-19	low	U 81- 9	0000	U 88-13	FC68
U 77-20	high	(TOTLZ=12519)		U 89- 1	low
U 77-21	8779	U 81-10	APC5	U 89- 2	low
U 77-22	high	U 81-11	5H6A	U 89- 4	low
U 78- 1	high	U 81-12	14AP	U 89- 5	low
U 78- 2	383A	U 81-13	383A	U 89- 8	low
(TOTLZ=0024)		(TOTLZ=0001)		U 89-11	low
U 78- 3	high	U 81-14	883F	U 90- 4	low
U 78- 4	low	U 81-15	C383	U 90- 5	high
U 78- 5	low	U 82- 1	low	U 90- 6	high
U 78- 6	low	U 82- 2	low	U 90- 7	low
U 78- 7	high	U 82- 3	high	U 90- 9	low
U 78- 9	FC68	U 82- 4	low	U 90-10	low
U 78-10	high	U 82- 5	low	U 90-11	low
U 78-11	AHAU	U 82- 6	high	U 90-12	high
U 78-12	9023	U 82- 8	high	U 90-14	high
U 78-13	CU1A	U 82- 9	low	U 90-15	high
U 78-14	AU73	U 82-10	high	U 91- 6	high

Performance Tests and Troubleshooting - Model 64601A

U 91- 7 high	U 95-14 8779	U 99- 8 87AA
U 91- 9 high	U 95-15 1166	U 99- 9 6UH0
U 91-10 high	U 96- 1 high	U 99-10 6UH0
U 91-11 high	U 96- 2 383A	U 99-11 4AA4
U 91-12 high	(TOTLZ=0024)	U 99-12 383A
U 91-13 high	U 96- 3 low	(TOTLZ=0001)
U 91-14 high	U 96- 4 high	U 99-13 high
U 91-15 high	U 96- 5 high	U100- 1 high
U 92- 1 high	U 96- 6 high	U100- 2 842U
U 92- 2 high	U 96- 7 high	U100- 3 0000
U 92- 5 low	U 96- 9 383A	(TOTLZ=12519)
U 92- 7 low	(TOTLZ=0001)	U100- 4 high
U 92- 9 high	U 96-10 U352	U100- 5 A1FH
U 92-10 low	U 96-11 4CP2	U100- 6 99U7
U 92-12 high	U 96-12 HU2A	U100- 8 A106
U 92-15 high	U 96-13 4521	U100- 9 993F
U 93- 1 high	U 96-14 986C	U100-10 high
U 93- 2 low	U 96-15 CC34	U100-11 0000
U 93- 5 low	U 97- 1 4743	(TOTLZ=12519)
U 93- 7 low	U 97- 2 87AA	U100-12 A900
U 93- 9 high	U 97- 3 8C0U	U100-13 high
U 93-10 high	U 97- 4 4AA4	U101- 1 383A
U 93-12 high	U 97- 5 4743	U101- 2 0000
U 93-15 high	U 97- 6 FA9P	U101- 4 low
U 94- 1 high	U 97- 8 FA9P	U101- 5 0000
U 94- 2 0000	U 97- 9 0U22	(TOTLZ=25038)
(TOTLZ=12519)	U 97-10 0000	U101-10 low
U 94- 3 high	U 97-11 968U	U101-11 high
U 94- 4 low	U 97-12 APC5	U101-12 high
U 94- 5 low	U 97-13 383A	U101-13 low
U 94- 6 low	(TOTLZ=12518)	
U 94- 7 high	U 98- 1 high	
U 94- 9 383A	U 98- 2 4743	
(TOTLZ=0024)	U 98- 3 7U79	
U 94-10 high	U 98- 4 FF2A	
U 94-11 UPF6	U 98- 5 4AA4	
U 94-12 12A9	U 98- 6 729P	
U 94-13 580H	U 98- 7 4AA4	
U 94-14 P816	U 98- 9 383A	
U 94-15 898A	(TOTLZ=25037)	
U 95- 1 high	U 98-10 87AA	
U 95- 2 0000	U 98-11 CU90	
(TOTLZ=12519)	U 98-12 87AA	
U 95- 3 high	U 98-13 968U	
U 95- 4 high	U 98-14 0000	
U 95- 5 low	U 98-15 383A	
U 95- 6 low	U 99- 1 383A	
U 95- 7 high	(TOTLZ=0001)	
U 95- 9 383A	U 99- 2 383A	
(TOTLZ=0024)	(TOTLZ=0025)	
U 95-10 898A	U 99- 3 14AP	
U 95-11 5AFC	U 99- 4 5H6A	
U 95-12 5632	U 99- 5 5H6A	
U 95-13 82PU	U 99- 6 5H6A	

Performance Tests and Troubleshooting - Model 64601A

64601A Timing Control Board  
DISPLAY TEST- 2ND PATTERN

QUAL MODE

VH = 383A

Qual = high

DATA THRESHOLD: ttl

CLOCK THRESHOLD: ttl

ST-SP-QL THRESHOLD: ttl

Location of ST/SP/START: tp 10

pos. edge

Location of QUAL/STOP: U99-12 or U 81-13

pos. edge

Location of CLOCK: tp 8

pos. edge

Location of GROUND: gnd

TTL

U 56- 1	high	U 58-16	5AFC	U 61- 4	high
U 56- 2	low	U 58-17	5632	U 61- 5	383A
U 56- 5	low	U 59- 1	P816	(TOTLZ=0025)	
U 56- 7	high	U 59- 2	580H	U 61- 6	0000
U 56- 9	high	U 59- 3	12A9	(TOTLZ=0024)	
U 56-10	high	U 59- 4	UPF6	U 61- 7	0000
U 56-12	low	U 59- 5	8779	U 61- 9	383A
U 56-15	high	U 59- 6	82PU	(TOTLZ=0001)	
U 57- 1	P816	U 59- 7	2A93	U 61-10	high
U 57- 2	580H	U 59- 8	high	U 61-11	CC34
U 57- 3	12A9	U 59-10	low	U 61-12	CC34
U 57- 4	UPF6	U 59-12	4CP2	U 61-13	383A
U 57- 5	8779	U 59-13	HU2A	(TOTLZ=0024)	
U 57- 6	82PU	U 59-14	4521	U 61-14	383A
U 57- 7	H02F	U 59-15	986C	U 61-15	383A
U 57- 8	high	U 59-16	5AFC	(TOTLZ=0024)	
U 57-10	low	U 59-17	5632	U 62- 1	high
U 57-12	4CP2	U 60- 1	low	U 62- 2	high
U 57-13	HU2A	U 60- 2	P816	U 62- 3	0000
U 57-14	4521	U 60- 3	H02F	(TOTLZ=12519)	
U 57-15	986C	U 60- 4	6037	U 62- 4	0000
U 57-16	5AFC	U 60- 5	C01C	(TOTLZ=12519)	
U 57-17	5632	U 60- 6	9549	U 62- 5	0000
U 58- 1	P816	U 60- 7	2A93	(TOTLZ=12519)	
U 58- 2	580H	U 60- 8	9549	U 62- 6	383A
U 58- 3	12A9	U 60- 9	4AA4	(TOTLZ=0024)	
U 58- 4	UPF6	U 60-11	0000	U 62- 7	383A
U 58- 5	8779	(TOTLZ=12519)		(TOTLZ=0024)	
U 58- 6	82PU	U 60-12	H02F	U 62- 9	U352
U 58- 7	6037	U 60-13	P816	U 62-10	U352
U 58- 8	high	U 60-14	C01C	U 62-11	1166
U 58-10	low	U 60-15	580H	U 62-12	383A
U 58-12	4CP2	U 60-16	637P	(TOTLZ=0001)	
U 58-13	HU2A	U 60-17	F6UF	U 62-13	383A
U 58-14	4521	U 61- 1	383A	U 62-14	high
U 58-15	986C	(TOTLZ=12518)		U 62-15	low
		U 61- 2	1166	U 63- 1	high
		U 61- 3	1166		

Performance Tests and Troubleshooting - Model 64601A

U 63- 2 383A (TOTLZ=0024)	U 78-13 CU1A	U 82- 9 low
U 63- 4 high	U 78-14 AU73	U 82-10 high
U 63- 5 383A (TOTLZ=0024)	U 78-15 U352	U 82-11 low
U 63- 6 0000 (TOTLZ=0024)	U 79- 1 low	U 82-12 high
U 63- 8 383A (TOTLZ=12518)	U 79- 2 low	U 82-13 high
U 63- 9 0000 (TOTLZ=12519)	U 79- 3 986C	U 83- 1 637P
U 63-10 high	U 79- 4 AHAU	U 83- 2 HC3C
U 63-12 383A (TOTLZ=12518)	U 79- 5 AU73	U 83- 3 383A (TOTLZ=12518)
U 63-13 high	U 79- 6 CU1A	U 83- 4 0000
U 76- 1 high	U 79- 7 9023	U 83- 5 4046
U 76- 2 H02F	U 79- 9 0U22	U 83- 6 P301
U 76- 4 6037	U 79-10 C584	U 83- 8 1281
U 76- 6 2A93	U 79-11 FF3U	U 83- 9 C86P
U 76-10 F6UF	U 79-12 2033	U 83-10 14AP
U 76-12 CAH5	U 79-13 low	U 83-13 14AP
U 76-14 CU43	U 79-14 low	U 84- 1 high
U 76-15 high	U 79-15 low	U 84- 2 0000
U 77- 1 UPF6	U 80- 1 580H	U 84- 3 383A (TOTLZ=0024)
U 77- 2 12A9	U 80- 2 C01C	U 84- 4 high
U 77- 3 580H	U 80- 3 H02F	U 84- 5 0000
U 77- 4 P816	U 80- 4 P816	U 84- 6 383A
U 77- 5 82PU	U 80- 5 2033	U 84- 8 low
U 77- 6 5632	U 80- 6 FF3U	U 84- 9 high
U 77- 7 5AFC	U 80- 7 C584	U 84-10 high
U 77- 8 low	U 80- 9 8054	U 84-11 0000
U 77-10 CU43	U 80-10 C86P	U 84-12 high
U 77-12 F6UF	U 80-11 H49C	U 84-13 high
U 77-13 high	U 80-12 368C	U 88- 1 low
U 77-14 high	U 80-13 low	U 88- 2 high
U 77-16 CAH5	U 80-14 low	U 88- 4 low
U 77-17 high	U 80-15 low	U 88- 8 H04A
U 77-18 low	U 81- 1 high	U 88- 9 P301
U 77-19 low	U 81- 2 HUA1	U 88-10 9PCU
U 77-20 high	U 81- 3 CU43	U 88-11 low
U 77-21 8779	U 81- 4 HUA1	U 88-12 U352
U 77-22 high	U 81- 5 6UH0	U 88-13 FC68
U 78- 1 high	U 81- 6 CAH5	U 89- 1 low
U 78- 2 383A (TOTLZ=0024)	U 81- 7 5H6A	U 89- 2 low
U 78- 3 high	U 81- 9 0000 (TOTLZ=12519)	U 89- 4 low
U 78- 4 low	U 81-10 APC5	U 89- 5 low
U 78- 5 low	U 81-11 5H6A	U 89- 8 low
U 78- 6 low	U 81-12 14AP	U 89-11 low
U 78- 7 high	U 81-13 383A (TOTLZ=0001)	U 90- 4 low
U 78- 9 FC68	U 81-14 1281	U 90- 5 high
U 78-10 high	U 81-15 H04A	U 90- 6 high
U 78-11 AHAU	U 82- 1 low	U 90- 7 low
U 78-12 9023	U 82- 2 low	U 90- 9 low
	U 82- 3 high	U 90-10 low
	U 82- 4 low	U 90-11 low
	U 82- 5 low	U 90-12 high
	U 82- 6 high	U 90-14 high
	U 82- 8 high	U 90-15 high

**Performance Tests and Troubleshooting - Model 64601A**

U 91- 6	high	U 95-13	82PU	U 99- 6	5H6A	
U 91- 7	high	U 95-14	8779	U 99- 8	87AA	
U 91- 9	high	U 95-15	1166	U 99- 9	6UH0	
U 91-10	high	U 96- 1	high	U 99-10	6UH0	
U 91-11	high	U 96- 2	383A	U 99-11	4AA4	
U 91-12	high	(TOTLZ=0024)			U 99-12	383A
U 91-13	high	U 96- 3	low	(TOTLZ=0001)		
U 91-14	high	U 96- 4	high	U 99-13	high	
U 91-15	high	U 96- 5	high	U100- 1	high	
U 92- 1	high	U 96- 6	high	U100- 2	368C	
U 92- 2	high	U 96- 7	high	U100- 3	0000	
U 92- 5	low	U 96- 9	383A	(TOTLZ=12519)		
U 92- 7	low	(TOTLZ=0001)			U100- 4	high
U 92- 9	high	U 96-10	U352	U100- 5	HC3C	
U 92-10	low	U 96-11	4CP2	U100- 6	P301	
U 92-12	high	U 96-12	HU2A	U100- 8	737F	
U 92-15	high	U 96-13	4521	U100- 9	4C46	
U 93- 1	high	U 96-14	986C	U100-10	high	
U 93- 2	low	U 96-15	CC34	U100-11	0000	
U 93- 5	low	U 97- 1	U4UC	U100-12	H49C	
U 93- 7	low	U 97- 2	87AA	U100-13	high	
U 93- 9	high	U 97- 3	A8H9	U101- 1	383A	
U 93-10	high	U 97- 4	4AA4	U101- 2	0000	
U 93-12	high	U 97- 5	U4UC	U101- 4	low	
U 93-15	high	U 97- 6	15PA	U101- 5	0000	
U 94- 1	high	U 97- 8	15PA	(TOTLZ=25038)		
U 94- 2	0000	U 97- 9	0022	U101-10	low	
(TOTLZ=12519)		U 97-10	0000	U101-11	high	
U 94- 3	high	U 97-11	968U	U101-12	high	
U 94- 4	low	U 97-12	APC5	U101-13	low	
U 94- 5	low	U 97-13	383A			
U 94- 6	low	(TOTLZ=12518)				
U 94- 7	high	U 98- 1	high			
U 94- 9	383A	U 98- 2	U4UC			
(TOTLZ=0024)		U 98- 3	FFF1			
U 94-10	high	U 98- 4	9PCU			
U 94-11	UPF6	U 98- 5	4AA4			
U 94-12	12A9	U 98- 6	729P			
U 94-13	580H	U 98- 7	4AA4			
U 94-14	P816	U 98- 9	383A			
U 94-15	898A	(TOTLZ=25037)				
U 95- 1	high	U 98-10	87AA			
U 95- 2	0000	U 98-11	CU90			
(TOTLZ=12519)		U 98-12	87AA			
U 95- 3	high	U 98-13	968U			
U 95- 4	high	U 98-14	0000			
U 95- 5	low	U 98-15	383A			
U 95- 6	low	U 99- 1	383A			
U 95- 7	high	(TOTLZ=0001)				
U 95- 9	383A	U 99- 2	383A			
(TOTLZ=0024)		(TOTLZ=0025)				
U 95-10	898A	U 99- 3	14AP			
U 95-11	5AFC	U 99- 4	5H6A			
U 95-12	5632	U 99- 5	5H6A			

Performance Tests and Troubleshooting - Model 64601A

64601A Timing Control Board  
DISPLAY TEST- 3RD PATTERN

QUAL MODE VH = 383A

Qual = high

DATA THRESHOLD: ttl

CLOCK THRESHOLD: ttl

ST-SP-QL THRESHOLD: ttl

Location of ST/SP/START: tp 10 pos. edge

Location of QUAL/STOP: U99-12 or U81-13 pos. edge

Location of CLOCK: tp 8 pos. edge

Location of GROUND: gnd

TTL

U 56- 1	high	U 58-16	5AFC	U 61- 4	high
U 56- 2	high	U 58-17	5632	U 61- 5	383A
U 56- 5	high	U 59- 1	P816	(TOTLZ=0025)	
U 56- 7	high	U 59- 2	580H	U 61- 6	0000
U 56- 9	high	U 59- 3	12A9	(TOTLZ=0024)	
U 56-10	high	U 59- 4	UPF6	U 61- 7	0000
U 56-12	low	U 59- 5	8779	U 61- 9	383A
U 56-15	high	U 59- 6	82PU	(TOTLZ=0001)	
U 57- 1	P816	U 59- 7	2A93	U 61-10	high
U 57- 2	580H	U 59- 8	high	U 61-11	CC34
U 57- 3	12A9	U 59-10	low	U 61-12	CC34
U 57- 4	UPF6	U 59-12	4CP2	U 61-13	383A
U 57- 5	8779	U 59-13	HU2A	(TOTLZ=0024)	
U 57- 6	82PU	U 59-14	4521	U 61-14	383A
U 57- 7	H02F	U 59-15	986C	U 61-15	383A
U 57- 8	high	U 59-16	5AFC	(TOTLZ=0024)	
U 57-10	low	U 59-17	5632	U 62- 1	high
U 57-12	4CP2	U 60- 1	low	U 62- 2	high
U 57-13	HU2A	U 60- 2	P816	U 62- 3	0000
U 57-14	4521	U 60- 3	H02F	(TOTLZ=12519)	
U 57-15	986C	U 60- 4	6037	U 62- 4	0000
U 57-16	5AFC	U 60- 5	C01C	(TOTLZ=12519)	
U 57-17	5632	U 60- 6	9549	U 62- 5	0000
U 58- 1	P816	U 60- 7	2A93	(TOTLZ=12519)	
U 58- 2	580H	U 60- 8	9549	U 62- 6	383A
U 58- 3	12A9	U 60- 9	4AA4	(TOTLZ=0024)	
U 58- 4	UPF6	U 60-11	0000	U 62- 7	383A
U 58- 5	8779	(TOTLZ=12519)		(TOTLZ=0024)	
U 58- 6	82PU	U 60-12	H02F	U 62- 9	U352
U 58- 7	6037	U 60-13	P816	U 62-10	U352
U 58- 8	high	U 60-14	C01C	U 62-11	1166
U 58-10	low	U 60-15	580H	U 62-12	383A
U 58-12	4CP2	U 60-16	637P	(TOTLZ=0001)	
U 58-13	HU2A	U 60-17	F6UF	U 62-13	383A
U 58-14	4521	U 61- 1	383A	U 62-14	high
U 58-15	986C	(TOTLZ=12518)		U 62-15	low
		U 61- 2	1166	U 63- 1	high
		U 61- 3	1166		

Performance Tests and Troubleshooting - Model 64601A

U 63- 2 383A (TOTLZ=0024)	U 78-13 CU1A	U 82- 9 low
U 63- 4 high	U 78-14 AU73	U 82-10 high
U 63- 5 383A (TOTLZ=0024)	U 78-15 U352	U 82-11 low
U 63- 6 0000 (TOTLZ=0024)	U 79- 1 low	U 82-12 high
U 63- 8 383A (TOTLZ=12518)	U 79- 2 high	U 82-13 high
U 63- 9 0000 (TOTLZ=12519)	U 79- 3 986C	U 83- 1 637P
U 63-10 high	U 79- 4 AHAU	U 83- 2 31F8
U 63-12 383A (TOTLZ=12518)	U 79- 5 AU73	U 83- 3 383A
U 63-13 high	U 79- 6 CU1A	(TOTLZ=12518)
U 76- 1 high	U 79- 7 9023	U 83- 4 0000
U 76- 2 H02F	U 79- 9 0U22	(TOTLZ=12519)
U 76- 4 6037	U 79-10 9286	U 83- 5 F637
U 76- 6 2A93	U 79-11 7923	U 83- 6 09U2
U 76-10 F6UF	U 79-12 PH28	U 83- 8 883F
U 76-12 CAH5	U 79-13 low	U 83- 9 8556
U 76-14 CU43	U 79-14 low	U 83-10 14AP
U 76-15 high	U 79-15 low	U 83-11 0000
U 77- 1 UPF6	U 80- 1 580H	U 83-12 0000
U 77- 2 12A9	U 80- 2 C01C	U 83-13 14AP
U 77- 3 580H	U 80- 3 H02F	U 84- 1 high
U 77- 4 P816	U 80- 4 P816	U 84- 2 0000
U 77- 5 82PU	U 80- 5 PH28	U 84- 3 383A
U 77- 6 5632	U 80- 6 7923	(TOTLZ=0024)
U 77- 7 5AFC	U 80- 7 9286	U 84- 4 high
U 77- 8 low	U 80- 9 CH6F	U 84- 5 0000
U 77-10 CU43	U 80-10 8556	U 84- 6 383A
U 77-12 F6UF	U 80-11 1716	U 84- 8 low
U 77-13 high	U 80-12 A424	U 84- 9 high
U 77-14 high	U 80-13 low	U 84-10 high
U 77-16 CAH5	U 80-14 low	U 84-11 0000
U 77-17 high	U 80-15 high	U 84-12 high
U 77-18 low	U 81- 1 high	U 84-13 high
U 77-19 low	U 81- 2 HUA1	U 88- 1 low
U 77-20 high	U 81- 3 CU43	U 88- 2 high
U 77-21 8779	U 81- 4 HUA1	U 88- 4 low
U 77-22 high	U 81- 5 6UH0	U 88- 6 383A
U 78- 1 high	U 81- 6 CAH5	U 88- 8 C383
U 78- 2 383A (TOTLZ=0024)	U 81- 7 5H6A	U 88- 9 09U2
U 78- 3 high	U 81- 9 0000	U 88-10 7A57
U 78- 4 low	(TOTLZ=12519)	U 88-11 low
U 78- 5 low	U 81-10 APC5	U 88-12 U352
U 78- 6 low	U 81-11 5H6A	U 88-13 FC68
U 78- 7 high	U 81-12 14AP	U 89- 1 low
U 78- 9 FC68	U 81-13 383A	U 89- 2 low
U 78-10 high	(TOTLZ=0001)	U 89- 4 low
U 78-11 AHAU	U 81-14 883F	U 89- 5 low
U 78-12 9023	U 81-15 C383	U 89- 8 low
	U 82- 1 low	U 89-11 low
	U 82- 2 low	U 90- 4 low
	U 82- 3 high	U 90- 5 high
	U 82- 4 low	U 90- 6 high
	U 82- 5 low	U 90- 7 low
	U 82- 6 high	U 90- 9 low
	U 82- 8 high	U 90-10 low

Performance Tests and Troubleshooting - Model 64601A

U 90-11	low	U 95- 9	383A	U 99- 2	383A
U 90-12	high	(TOTLZ=0024)		(TOTLZ=0025)	
U 90-14	high	U 95-10	898A	U 99- 3	14AP
U 90-15	high	U 95-11	5AFC	U 99- 4	5H6A
U 91- 6	high	U 95-12	5632	U 99- 5	5H6A
U 91- 7	high	U 95-13	82PU	U 99- 6	5H6A
U 91- 9	high	U 95-14	8779	U 99- 8	87AA
U 91-10	high	U 95-15	1166	U 99- 9	6UH0
U 91-11	high	U 96- 1	high	U 99-10	6UH0
U 91-12	high	U 96- 2	383A	U 99-11	4AA4
U 91-13	high	(TOTLZ=0024)		U 99-12	383A
U 91-14	high	U 96- 3	low	(TOTLZ=0001)	
U 91-15	high	U 96- 4	high	U 99-13	high
U 92- 1	high	U 96- 5	high	U100- 1	high
U 92- 2	high	U 96- 6	high	U100- 2	A424
U 92- 5	low	U 96- 7	high	U100- 3	0000
U 92- 7	low	U 96- 9	383A	(TOTLZ=12519)	
U 92- 9	high	(TOTLZ=0001)		U100- 4	high
U 92-10	low	U 96-10	U352	U100- 5	31F8
U 92-12	high	U 96-11	4CP2	U100- 6	09U2
U 92-15	high	U 96-12	HU2A	U100- 8	UP0H
U 93- 1	high	U 96-13	4521	U100- 9	F637
U 93- 2	low	U 96-14	986C	U100-10	high
U 93- 5	low	U 96-15	CC34	U100-11	0000
U 93- 7	low	U 97- 1	AU47	(TOTLZ=12519)	
U 93- 9	high	U 97- 2	87AA	U100-12	1716
U 93-10	high	U 97- 3	P74A	U100-13	high
U 93-12	high	U 97- 4	4AA4	U101- 1	383A
U 93-15	high	U 97- 5	AU47	U101- 2	0000
U 94- 1	high	U 97- 6	C126	U101- 4	low
U 94- 2	0000	U 97- 8	C126	U101- 5	0000
(TOTLZ=12519)		U 97- 9	0U22	(TOTLZ=25038)	
U 94- 3	high	U 97-10	0000	U101- 6	383A
U 94- 4	low	U 97-11	968U	(TOTLZ=25037)	
U 94- 5	low	U 97-12	APC5	U101-10	low
U 94- 6	low	U 97-13	383A	U101-11	high
U 94- 7	high	(TOTLZ=12518)		U101-12	high
U 94- 9	383A	U 98- 1	high	U101-13	low
(TOTLZ=0024)		U 98- 2	AU47		
U 94-10	high	U 98- 3	977H		
U 94-11	UPF6	U 98- 4	7A57		
U 94-12	12A9	U 98- 5	4AA4		
U 94-13	580H	U 98- 6	729P		
U 94-14	P816	U 98- 7	4AA4		
U 94-15	898A	U 98- 9	383A		
U 95- 1	high	(TOTLZ=25037)			
U 95- 2	0000	U 98-10	87AA		
(TOTLZ=12519)		U 98-11	CU90		
U 95- 3	high	U 98-12	87AA		
U 95- 4	high	U 98-13	968U		
U 95- 5	low	U 98-14	0000		
U 95- 6	low	U 98-15	383A		
U 95- 7	high	U 99- 1	383A		
		(TOTLZ=0001)			

SECTION V

ADJUSTMENTS

5-1. INTRODUCTION.

5-2. This section describes adjustments and checks required to return the instrument to peak operating capability after repairs have been made.

5-3. SAFETY REQUIREMENTS.

5-4. Although this instrument has been designed in accordance with international safety standards, general safety precautions must be observed during all phases of operation, service, and repair of the instrument. Failure to comply with precautions listed in the Safety Summary at the front of this manual or with specific warnings given throughout the manual could result in serious injury or death or damage to equipment. Service adjustments should be performed only by qualified service personnel.

5-5. EQUIPMENT REQUIRED.

5-6. HP 64000 series mainframe.

2 HP 64602-66501 200MHz Data Acq. Boards.

2 HP 64604A Timing Probes

2 HP 64604-61601 Timing Cables.

HP 1722B Scope or equivalent.

HP 5314A Universal Counter or equivalent.

HP 10017 Probe or equivalent.

BNC Coaxial Cable approx. 1 meter long.

Alignment Tool.

Small Screwdriver.

HP 64110-66503 Extender Board. (Part of 64934A Service Kit)

4 Extended coaxial clock cables. (Part of 64934B Service Kit)

HP 3-way extended timing bus cable. (Part of 64934B Service Kit)

**Adjustments - Model 64601A**

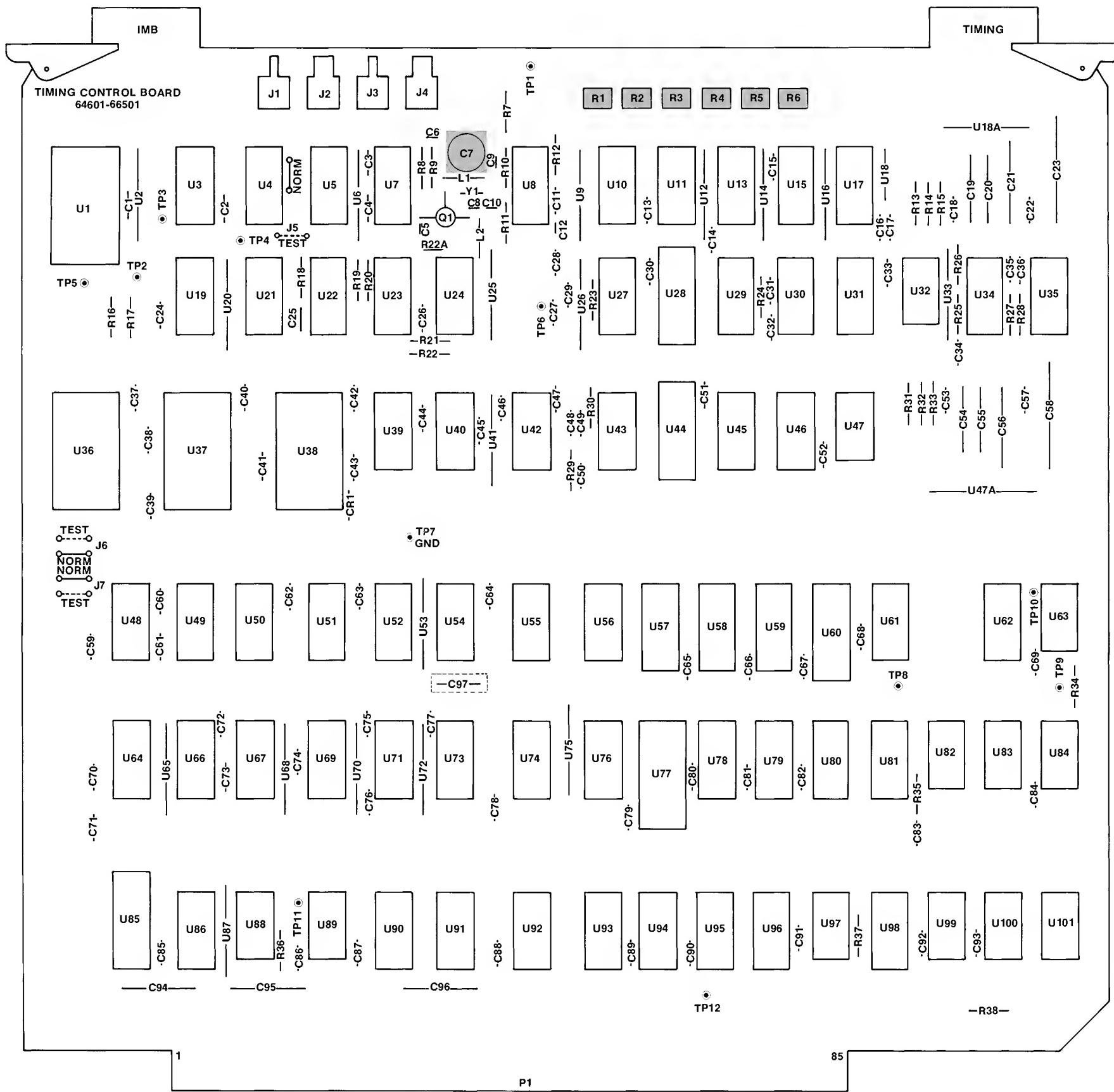


Figure 5-1. Adjustments  
CTL 5-2

5-7. SAMPLE-RATE OSCILLATOR CALIBRATION.

5-8. Setup.

5-9. TP1, the coaxial testpoint for the oscillator, is located at the very top-center of the board (when viewing from the component side). The oscillator transistor (Q1), and its trimmer capacitor (C7), are located at the top of the board between U7 and U8. See figure 5-1.

5-10. Using the mainframe keyboard and softkeys configure the timing analyzer for the oscillator adjustment as follows:

- a. Press softkey "timing", then [RETURN]. The screen should show the trace specification.
- b. Verify that the "mode\_is wide\_sample", and the "sample rate\_is 200 MHz".
- c. Press the softkeys "trigger on entering POD1.0 = 0XXH". [RETURN]
- d. Press "execute". [RETURN]

5-11. Adjustment

- a. Connect the probe to the 64602A acquisition board through the timing cable. Leave the probe leads disconnected.
- b. Connect channel A of the scope to testpoint 1. Since this is a coaxial test point, no ground clip is necessary.
- c. Set up CHANNEL A VOLTS/DIV to .01 (100mv/div. with the X10 probe), and AC couple the input.
- d. Set up HORIZ DISPLAY to MAG X10 and MAIN.
- e. Set up TIME/DIV to 10ns/div. (This is actually 1ns/div., since MAG X10 has been selected).
- f. If no signal is present adjust the trimmer capacitor on the upper middle part of the board until a sinusoidal signal is observed (try to adjust the capacitor to the middle of the range when the sinusoid is observed). NOTE: USE A NON-CONDUCTIVE ALIGNMENT TOOL ONLY!!! (ISOLATION IS REQUIRED).
- g. The sinusoidal waveform should have an amplitude of 100 to 150mV and a frequency of 200MHz (2 periods/screen on 1ns/div.).

**Adjustments - Model 64601A**

**SAMPLE RATE OSCILLATOR CALIBRATION (continued)**

- h. To determine if the oscillator is stable, tap the collector of the high frequency transistor lightly with the blade of a small screwdriver to see if the oscillator will come back to a stable 200MHz oscillation.

HIGH FREQUENCY TRANSISTOR: --0-|-----<-----collector  
(located below the trimmer cap.)

- i. If the oscillator will not come back with the correct oscillation, readjust the trimmer capacitor and repeat the last step to ensure a stable oscillation.
- j. Connect the scope probe BNC to INPUT A of the 5314A Universal Counter. Set up the counter for NORM FREQ A 10Hz RESOLUTION positive SLOPE ATTN X1 and adjust LEVELA on the counter to approximately the middle position.
- k. Connect the scope probe tip to TP4 (located between U4 and U20) , and connect the ground lead of the scope probe to TP7 (GND).
- l. The counter should display 50MHz +/- 0.01% (49995kHz - 50005kHz).

Press softkey "end". Press [RETURN].

5-12. TRIGGER DURATION CALIBRATION (R1 through R6)

5-13. Besides the previous sample rate oscillator adjustment, there are six adjustments for trigger duration on the 64601A control board. The six pots, R1-R6, are located at the top of the board (when viewed from the component side). The last three adjustments, R4-R6, are for a 16-channel, two-acquisition board system ONLY.

5-14. The duration pots, R1-R6 at the top of the 64601A control board, determine the pattern duration required for triggering.

5-15. Use PV tests 6 and 10 for adjustment of R1 through R6. For an 8-channel single acquisition board system only R1, R2 and R3 need to be adjusted.

## Adjustments - Model 64601A

### 5-19. 8-Channel Adjustment. (R1 through R3)

Test 6 consists of nine test steps, five in braces, and four in brackets: {00000}[0000]. We are concerned only with the four in brackets. All four should be 0. If they are not, proceed as follows:

1. Adjust R1 until the second digit from the right is 0.
2. Adjust R2 until the third digit from the right is 0.
3. Adjust R3 until the fourth digit from the right is 0.
4. The first bracket digit indicates whether the others are correct. It should now be 0 also.
5. Press the "stop" softkey.
6. Press the "end" softkey.

### 5-20. 16-Channel Keyboard Setup. (R4 through R6)

Use the following procedure to adjust R4-R6 in a system containing a second 64602A acquisition board.

- a. Press softkey "option\_test". [RETURN]
- b. The screen should list all the option boards installed in your system. Type in the slot number for the 64601A control board. [RETURN]
- c. Press softkey "run".
- d. Press softkey "slot".
- e. The screen should list the timing analyzer boards in the system. Type in the slot number for the 64601A control board.
- f. Press softkey "test".
- g. The screen should list the 15 control board PV tests. Type in "10".
- h. Type in "cal". [RETURN]

## 5-21. 16-channel adjustment procedure. (R4 through R6)

When test 10 is displayed, nine digits are shown: five in braces, and four in brackets. We are concerned only with the four bracket digits. The four digits in brackets should all be 0. If they are not, proceed as follows:

1. Adjust R4 until the second digit from the right is 0.
2. Adjust R5 until the third digit from the right is 0.
3. Adjust R6 until the fourth digit from the right is 0.
4. The first digit from the right should be 0 when the other three are 0.
5. Press the "stop" softkey. [RETURN]
6. Press the "end" softkey. [RETURN].

**Adjustments - Model 64601A**

**NOTES**

## SECTION VI

### REPLACEABLE PARTS

#### 6-1. INTRODUCTION.

6-2. This section contains information for ordering parts. Table 6-1 lists abbreviations used in the parts list and throughout the manual. Table 6-2 lists all replaceable parts in reference designator order. Table 6-3 contains the names and addresses that correspond to the manufacturers' five-digit code numbers.

#### 6-3. ABBREVIATIONS.

6-4. Table 6-1 lists abbreviations used in the parts list, the schematics and throughout the manual. In some cases, two forms of the abbreviation are used: one all in capital letters, and one partial or no capitals. This occurs because the abbreviations in the parts list are always capitals. However, in the schematics and other parts of the manual, other abbreviation forms are used with both lowercase and uppercase letters.

#### 6-5. REPLACEABLE PARTS LIST.

6-6. Table 6-2 is the list of replaceable parts and is organized as follows:

- a. Chassis-mounted parts in alphanumerical order by reference designation.
- b. Electrical assemblies and their components in alphanumerical order by reference designation.
- c. Miscellaneous parts.

The information given for each part consists of the following:

- a. The Hewlett-Packard part number and the check digit.
- b. The total quantity (Qty) in the instrument.
- c. The description of the part.
- d. A five-digit code that indicates the manufacturer.
- e. The manufacturer's part number.

The total quantity for each part is given only once--at the first appearance of the part number in the list.

## **Replaceable Parts - Model 64601A**

### **6-7. ORDERING INFORMATION.**

**6-8.** To order a part listed in the replaceable parts table, quote the Hewlewtt-Packard part number and check digit, indicate the quantity required, and address the order to the nearest Hewlett-Packard office.

**6-9.** To order a part that is not listed in the replaceable parts table, include the instrument model number, instrument repair number, the description and function of the part, and the number of parts required. Address the order to the nearest Hewlett-Packard office.

### **6-10. SPARE PARTS KIT.**

**6-11.** A service kit is available. To order, please contact your local sales and service representative.

### **6-12. DIRECT MAIL ORDER SYSTEM.**

**6-13.** Within the USA, Hewlett-Packard can supply parts through a direct mail order system. Advantages of using the system are as follows:

- a. Direct ordering and shipment from the HP Parts Center in Mountain View California.
- b. No Maximum or minimum on any mail order (there is a minimum order amount, for parts ordered through a local HP office when the orders require billing and invoicing).
- c. Prepaid transportation (A small handling charge for each order).
- d. No invoices--to provide these advantages, a check or money order must accompany each order.

**6-14.** Mail-order forms and specific ordering information are available through your local HP office. Addresses and phone numbers are located at the back of this manual.

Table 6-1. Reference Designators and Abbreviations

REFERENCE DESIGNATORS					
<b>A</b>	= assembly	<b>F</b>	- fuse	<b>MP</b>	- mechanical part
<b>B</b>	= motor	<b>FL</b>	= filter	<b>P</b>	- plug
<b>BT</b>	= battery	<b>IC</b>	= integrated circuit	<b>O</b>	- transistor
<b>C</b>	= capacitor	<b>J</b>	= jack	<b>R</b>	- resistor
<b>CP</b>	= coupler	<b>K</b>	= relay	<b>RT</b>	= thermistor
<b>CR</b>	= diode	<b>L</b>	= inductor	<b>S</b>	- switch
<b>DL</b>	= delay line	<b>LS</b>	= loud speaker	<b>T</b>	- transformer
<b>DS</b>	= device signaling (lamp)	<b>M</b>	= meter	<b>TB</b>	= terminal board
<b>E</b>	= misc electronic part	<b>MK</b>	= microphone	<b>TP</b>	= test point
ABBREVIATIONS					
<b>A</b>	= amperes	<b>H</b>	= henries	<b>N/O</b>	= normally open
<b>AFC</b>	= automatic frequency control	<b>HDW</b>	= hardware	<b>NOM</b>	= nominal
<b>AMPL</b>	= amplifier	<b>HEX</b>	= hexagonal	<b>NPO</b>	- negative positive zero (zero temperature coefficient)
<b>BFO</b>	= beat frequency oscillator	<b>HG</b>	= mercury	<b>NPN</b>	- negative-positive-negative
<b>BE CU</b>	= beryllium copper	<b>HR</b>	= hour(s)	<b>NRFR</b>	= not recommended for field replacement
<b>BH</b>	= binder head	<b>HZ</b>	= hertz	<b>NSR</b>	= not separately replaceable
<b>BP</b>	= bandpass	<b>IF</b>	= intermediate freq	<b>OBD</b>	- order by description
<b>BRS</b>	= brass	<b>IMPG</b>	= impregnated	<b>OH</b>	- oval head
<b>BWO</b>	= backward wave oscillator	<b>INCD</b>	= incandescent	<b>OX</b>	- oxide
<b>CCW</b>	= counter-clockwise	<b>INCL</b>	- includes	<b>PH BRZ</b>	- peak
<b>CER</b>	= ceramic	<b>INS</b>	= insulation(ed)	<b>PC</b>	= printed circuit
<b>CMO</b>	= cabinet mount only	<b>INT</b>	= internal	<b>PF</b>	- picofarads- 10 12 farads
<b>COEF</b>	= coefficient	<b>K</b>	= kilo=1000	<b>PHL</b>	- phillips
<b>COM</b>	= common	<b>LH</b>	= left hand	<b>PIV</b>	- peak inverse voltage
<b>COMP</b>	= composition	<b>LIN</b>	= linear taper	<b>PNP</b>	- positive-negative-positive
<b>COMPL</b>	= complete	<b>LK WASH</b>	= lock washer	<b>P/O</b>	- part of
<b>CONN</b>	= connector	<b>LOG</b>	= logarithmic taper	<b>POLY</b>	- polystyrene
<b>CP</b>	= cadmium plate	<b>LPF</b>	= low pass filter	<b>PORC</b>	- porcelain
<b>CRT</b>	= cathode-ray tube	<b>M</b>	= milli=10 <sup>-3</sup>	<b>POS</b>	- position(s)
<b>CW</b>	= clockwise	<b>MEG</b>	= meg=10 <sup>6</sup>	<b>POT</b>	- potentiometer
<b>DEPC</b>	= deposited carbon	<b>MET FLM</b>	= metal film	<b>PP</b>	- peak-to-peak
<b>DR</b>	= drive	<b>MET OX</b>	= metallic oxide	<b>PT</b>	- point
<b>ELECT</b>	= electrolytic	<b>MFR</b>	= manufacturer	<b>PWV</b>	= peak working voltage
<b>ENCAP</b>	= encapsulated	<b>MHZ</b>	= mega hertz		
<b>EXT</b>	= external	<b>MINAT</b>	= miniature		
<b>F</b>	= farads	<b>MOM</b>	= momentary		
<b>FH</b>	= flat head	<b>MOS</b>	= metal oxide substrate		
<b>FIL H</b>	= fillister head	<b>MTG</b>	= mounting		
<b>FXD</b>	= fixed	<b>MY</b>	= "mylar"		
<b>G</b>	- giga (10 <sup>9</sup> )	<b>N</b>	- nano (10 <sup>-9</sup> )	<b>RECT</b>	- rectifier
<b>GE</b>	= germanium	<b>N/C</b>	- normally closed	<b>RF</b>	- radio frequency
<b>GL</b>	= glass	<b>NE</b>	= neon	<b>RH</b>	- round head or right hand
<b>GRD</b>	= grounded	<b>NI PL</b>	= nickel plate		
				<b>U</b>	integrated circuit
				<b>V</b>	- vacuum, tube, neon bulb, photocell, etc
				<b>VR</b>	- voltage regulator
				<b>W</b>	- cable
				<b>X</b>	- socket
				<b>Y</b>	- crystal
				<b>Z</b>	- tuned cavity network

# Replaceable Parts - Model 64601A

Table 6-2. Replaceable Parts List

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
	64601A	9	1	TIMING ANALYSTS CONTROL BOARD	28480	64601A
A1	64601-66501	1	1	TIMING CONTROL BOARD	28480	64601-66501
A1C1	0160-2055	9	65	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C2	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C3	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C4	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C5	0160-3879	7	3	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3879
A1C6	0160-3879	7	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3879
A1C7	0121-0061	1	1	CAPACITOR-V TRMR-CER 5.5-18PF 350V	52763	304322 5.5/18PF NPO
A1C8	0160-4383	0	1	CAPACITOR-FXD 6.8PF +-5PF 200VDC CER	20932	5024E0200RD689D
A1C9	0160-3874	2	6	CAPACITOR-FXD 10PF +-5PF 200VDC CER	28480	0160-3874
A1C10	0160-3874	2	1	CAPACITOR-FXD 10PF +-5PF 200VDC CER	28480	0160-3874
A1C11	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C12	0160-3879	7	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3879
A1C13	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C14	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C15	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	20480	0160-2055
A1C16	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	20480	0160-2055
A1C17	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C18	0140-0199	6	2	CAPACITOR-FXD 240PF +-5% 300VDC MICA	72136	DM15F24110300WV1CR
A1C19	0160-5415	1	2	CAPACITOR-FXD 3600PF 50VDC	28480	0160-5415
A1C20	0160-5343	4	2	CAPACITOR-FXD .04UF 50VDC	28480	0160-5343
A1C21	0160-5342	3	2	CAPACITOR-FXD .4UF 50VDC	28480	0160-5342
A1C22	0160-3874	2	1	CAPACITOR-FXD 10PF +-5PF 200VDC CER	20480	0160-3874
A1C23	0160-5341	2	2	CAPACITOR-FXD 4UF 50VDC	28480	0160-5341
A1C24	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28400	0160-2055
A1C25	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C26	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C27	0160-3874	2	1	CAPACITOR-FXD 10PF +-5PF 200VDC CER	28480	0160-3874
A1C28	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C29	0160-4813	1	3	CAPACITOR-FXD 180PF +-5% 180VDC CFR	20480	0160-4813
A1C30	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CFR	28400	0160-2055
A1C31	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C32	0160-4492	2	2	CAPACITOR-FXD 18PF +-5% 200VDC CER 04-30	28480	0160-4492
A1C33	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C34	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C35	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C36	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C37	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C38	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C39	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C40	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28400	0160-2055
A1C41	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	20480	0160-2055
A1C42	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C43	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C44	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C45	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C46	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C47	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C48	0160-4813	1	1	CAPACITOR-FXD 180PF +-5% 180VDC CER	20480	0160-4813
A1C49	0160-3874	2	1	CAPACITOR-FXD 10PF +-5PF 200VDC CER	28480	0160-3874
A1C50	0160-4492	2	1	CAPACITOR-FXD 10PF +-5% 200VDC CFR 04-30	28480	0160-4492
A1C51	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C52	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C53	0140-0199	6	1	CAPACITOR-FXD 240PF +-5% 300VDC MICA	72136	DM15F24110300WV1CR
A1C54	0160-5415	1	1	CAPACITOR-FXD 3600PF 50VDC	28480	0160-5415
A1C55	0160-5343	4	1	CAPACITOR-FXD .04UF 50VDC	28480	0160-5343
A1C56	0160-5342	3	1	CAPACITOR-FXD .4UF 50VDC	28480	0160-5342
A1C57	0160-3874	2	1	CAPACITOR-FXD 10PF +-5PF 200VDC CER	28480	0160-3874
A1C58	0160-5341	2	1	CAPACITOR-FXD 4UF 50VDC	28480	0160-5341
A1C59	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C60	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C61	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CFR	28480	0160-2055
A1C62	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CFR	20480	0160-2055
A1C63	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C64	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C65	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C66	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C67	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C68	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C69	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C70	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055

See introduction to this section for ordering information

\*Indicates factory selected value

Table 6-2. Replaceable Parts List (Con't)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1C71	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C72	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C73	0160-2055	9		CAPACITOR-FXD .010F +80-20% 100VDC CER	28480	0160-2055
A1C74	0160-4813	1		CAPACITOR-FXD 180PF +-5% 100VDC CER	28480	0160-4813
A1C75	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C76	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C77	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C78	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C79	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C80	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C81	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C82	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C83	0140-0190	5	1	CAPACITOR-FXD 200PF +-5% 300VDC MICA	72136	DM15F201J0300WV1CR
A1C84	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C85	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C86	0160-4008	4	1	CAPACITOR-FXD 470PF +-5% 100VDC CER	28480	0160-4008
A1C87	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C88	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C89	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C90	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C91	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C92	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C93	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C94	0180-0374	3	3	CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	1500106X9020B2
A1C95	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	1500106X9020B2
A1C96	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	1500106X9020B2
A1CR1	1901-0040	1	1	DIDDE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1J1	1250-0543	8	2	CONNECTOR-RF SM-SNP M PC 50-OHM	28400	1250-0543
A1J2	1250-1189	0	2	CONNECTOR-RF SMB FEM PC 50-OHM	28400	1250-1189
A1J3	1250-0543	9		CONNECTOR-RF SM-SNP M PC 50-OHM	28400	1250-0543
A1J4	1250-1189	0		CONNECTOR-RF SMR FEM PC 50-OHM	28400	1250-1189
A1L1	9100-2247	4	1	INDUCTOR RF-CH-MLD 100NH 10% .105DX.26LG	28480	9100-2247
A1L2	9100-2248	5	1	INDUCTOR RF-CH-MLD 120NH 10% .105DX.26LG	28480	9100-2248
A1MP1	1400-0116	8	1	PIN-CRV .062-IN-DIA .25-IN-LG STL	28480	1400-0116
A1MP2	64601-85001	6	1	BOARD EJECTOR	28480	64601-85001
A1MP3	64601-85002	7	1	BOARD EJECTOR	28480	64601-85002
A1P1	1258-0182	7	3	CONNECTOR-R & P 1 MALE PLUG	28480	1258-0182
A1P2	1258-0182	7		CONNECTOR-R & P 1 MALE PLUG	28480	1258-0182
A1P3	1258-0182	7		CONNECTOR-R & P 1 MALE PLUG	28480	1258-0182
A1Q1	1854-0591	6	1	TRANSISTOR NPN SI PD=180MW FT=4GHZ	25403	EFR-90
A1R1	2100-3352	7	4	RESISTOR-TRMR 1K 10% C SIDE-ADJ 1-TRN	28480	2100-3352
A1R2	2100-3352	7		RESISTOR-TRMR 1K 10% C SIDE-ADJ 1-TRN	28480	2100-3352
A1R3	2100-3351	6	2	RESISTOR-TRMR 500 10% C SIDE-ADJ 1-TRN	28480	2100-3351
A1R4	2100-3352	7	2	RESISTOR-TRMR 1K 10% C SIDE-ADJ 1-TRN	28480	2100-3352
A1R5	2100-3352	7		RESISTOR-TRMR 1K 10% C SIDE-ADJ 1-TRN	28480	2100-3352
A1R6	2100-3351	6		RESISTOR-TRMR 500 10% C SIDE-ADJ 1-TRN	28480	2100-3351
A1R7	0757-0280	3	4	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R8	0757-0401	0	3	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R9	0757-0394	0	1	RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A1R10	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R11	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R12	0757-0410	1	1	RESISTOR 301 1% .125W F TC=0+-100	24546	C4-1/8-T0-301R-F
A1R13	0757-0426	9	2	RESISTOR 1.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1X01-F
A1R14	0757-0427	0	2	RESISTOR 1.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1501-F
A1R15	0757-0414	5	2	RESISTOR 432 1% .125W F TC=0+-100	24546	C4-1/8-T0-432R-F
A1R16	0698-3132	4	1	RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A1R17	0257-0405	4	1	RESISTOR 162 1% .125W F TC=0+-100	24546	C4-1/8-T0-162R-F
A1R18	0757-0391	7	6	RESISTOR 39.2 1% .125W F TC=0+-100	24546	C4-1/8-T0-39R2-F
A1R19	0757-0391	7		RESISTOR 39.2 1% .125W F TC=0+-100	24546	C4-1/8-T0-39R2-F
A1R20	0757-0391	7		RESISTOR 39.2 1% .125W F TC=0+-100	24546	C4-1/8-T0-39R2-F

See introduction to this section for ordering information

\*Indicates factory selected value

Replaceable Parts - Model 64601A

Table 6-2. Replaceable Parts List (Con't)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1R21	0757-0391	7		RESISTOR 39.2 1% .125W F TC=0+-100	24546	C4-1/8-T0-39R2-F
A1R22	0757-0391	7		RESISTOR 39.2 1% .125W F TC=0+-100	24546	C4-1/8-T0-39R2-F
A1R2A	0757-0391	7		RESISTOR 39.2 1% .125W F TC=0+-100	24546	C4-1/8-T0-39R2-F
A1R23	0757-0407	6	5	RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A1R24	0757-0407	6	5	RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A1R25	0757-0416	7	5	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1R26	0757-0416	7	5	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1R27	0757-0416	7	5	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1R28	0757-0416	7	5	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1R29	0757-0407	6	5	RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A1R30	0757-0407	6	5	RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A1R31	0757-0426	9		RESISTOR 1.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1301-F
A1R32	0757-0427	0		RESISTOR 1.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1501-F
A1R33	0757-0414	5		RESISTOR 432 1% .125W F TC=0+-100	24546	C4-1/8-T0-432R-F
A1R34	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R35	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1R36	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1R37	0757-0407	6		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A1R38	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1TP1	1250-1737	4	1	COAXIAL TEST POINT	28480	1250-1737
A1TP2	0360-0535	0	11	TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A1TP3	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A1TP4	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A1TP5	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A1TP6	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A1TP7	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A1TP8	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A1TP9	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A1TP10	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A1TP11	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A1TP12	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A1U1	1N84-500B	9	4	IC-DELAY	28480	1N84-500B
A1U2	1810-0273	9	1	NETWORK-RES 10-SIP470.0 OHM X 9	01121	210A471
A1U3	1820-2359	7	1	IC MISC ECL 14-INP	07263	F10014PC
A1U4	1820-1359	5	1	IC MUXR/DATA-SEL ECL 4-TO-1-LINE DUAL	04713	MC10174P
A1U5	1820-1225	4	3	IC FF ECL D-M/S DUAL	04713	MC10231P
A1U6	1810-0271	7	9	NETWORK-RFS 10-SIP200.0 OHM X 9	01121	211A201
A1U7	1820-1320	0	2	IC RCVR ECL LINE RCVR TPL 2-INP	04713	MC10216L
A1U8	1820-0920	4	1	IC RCVR ECL LINE RCVR QUAD 2-INP	04713	MC1692L
A1U9	1810-0272	8	7	NETWORK-RES 10-SIP330.0 OHM X 9	01121	210A331
A1U10	1820-2193	7	5	IC FF ECL D-M/S POS-EDGE-TRIG COM CLOCK	04713	MC10176L
A1U11	1820-2193	7		IC FF ECL D-M/S POS-EDGE-TRIG COM CLOCK	04713	MC10176L
A1U12	1810-0272	8		NETWORK-RES 10-SIP330.0 OHM X 9	01121	210A331
A1U13	1820-0815	6	3	IC GATE ECL AND-OR	04713	MC10121P
A1U14	1810-0272	8		NETWORK-RES 10-SIP330.0 OHM X 9	01121	210A331
A1U15	1820-2193	7		IC FF ECL D-M/S POS-EDGE-TRIG COM CLOCK	04713	MC10176L
A1U16	1810-0271	7		NETWORK-RES 10-SIP200.0 OHM X 9	01121	210A201
A1U17	1820-0815	6		IC GATE ECL AND-OR	04713	MC10121P
A1U18A	1810-0281	9	2	NETWORK-RES 10-SIP100.0K OHM X 9	01121	210A104
A1U18B	1810-0541	4	1	NETWORK-RES 6-SIP MULTI-VALUE	28480	1810-0541
A1U19	1820-0802	1	6	IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A1U20	1810-0271	7		NETWORK-RES 10-SIP200.0 OHM X 9	01121	210A201
A1U21	1820-0802	1		IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A1U22	1820-2664	7	1	IC CNTR ECL BI-QUINARY R-S POS-EDGE-TRIG	04713	MC1678L
A1U23	1820-1225	4		IC FF ECL D-M/S DUAL	04713	MC10231P
A1U24	1820-0796	2	1	IC GATE ECL NOR QUAD 2-INP	04713	MC1662L
A1U25	1810-0272	8		NETWORK-RES 10-SIP330.0 OHM X 9	01121	210A331
A1U26	1810-0271	7		NETWORK-RES 10-SIP200.0 OHM X 9	01121	210A201
A1U27	1820-0802	1	6	IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A1U28	1820-1730	6	2	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A1U29	1810-0402	6	2	NETWORK-RFS 16-DIP330.0 OHM X 8	01121	316B331
A1U30	1810-0243	3	1	NETWORK-RES 16-DIP6.8K OHM X 8	01121	316B682
A1U31	1N88-0054	4	2	TRANSISTOR ARRAY 16-PIN PLSTC DIP	28480	1N88-0054
A1U32	1N81-0002	5	2	TRANSISTOR ARRAY 14-PIN CER DIP	3L585	CA3045
A1U33	1810-0271	7		NETWORK-RFS 10-SIP200.0 OHM X 9	01121	210A201
A1U34	1820-1320	0		IC RCVR ECL LINE RCVR TPL 2-INP	04713	MC10216L
A1U35	1820-1946	6	3	IC GATE ECL DUAL	04713	MC10117L
A1U36	1N84-500B	9		IC-DELAY	28480	1N84-500B
A1U37	1N84-500B	9		IC-DELAY	28480	1N84-500B
A1U38	1N84-500B	9		IC-DELAY	28400	1N84-500B
A1U39	1820-1993	3	1	IC MUXR/DATA-SEL ECL QUAD 2-INP	04713	MC10158L
A1U40	1820-1225	4		IC FF ECL D-M/S DUAL	04713	MC10231P
A1U41	1810-0271	7		NETWORK-RES 10-SIP200.0 OHM X 9	01121	210A201
A1U42	1820-1946	6		IC GATE ECL DUAL	04713	MC10117L
A1U43	1820-0802	1		IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A1U44	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A1U45	1010-0402	6		NETWORK-RES 16-DIP330.0 OHM X 8	01121	316B331

See introduction to this section for ordering information

\*Indicates factory selected value

Table 6-2. Replaceable Parts List (Con't)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1U46	1858-0054	4		TRANSISTOR ARRAY 16-PIN PLSTC DIP	28480	1858-0054
A1U47A	1810-0281	9		NETWORK-RES 10-SIP100.0 OHM X 9	01121	210A104
A1U47	1821-0002	5		TRANSISTOR ARRAY 14-PIN CER DIP	3L585	CA3045
A1U48	1820-0780	4	1	IC DRVR TTL LINE DRVR QUAD	27014	D60031N
A1U49	1820-1052	5	2	IC XLTR ECL ECL-TO-TTL QUAD 2-INP	04713	MC10125L
A1U50	1820-1946	6		IC GATE ECL DUAL	04713	MC10117L
A1U51	1820-0817	8	2	IC FF ECL D-M/S DUAL	04713	MC10131P
A1U52	1820-1788	4	1	IC CNTR ECL BIN SYNCHRO POS-EDGE-TRIG	07263	F10016DC
A1U53	1810-0271	7		NETWORK-RES 10-SIP200.0 OHM X 9	01121	210A201
A1U54	1820-0802	1		IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A1U55	1820-0815	6		IC GATE ECL AND-OR	04713	MC10121P
A1U56	1820-1196	8	3	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
A1U57	1818-1596	7	3	IC CMOS 4096 (4K) STAT RAM 55-NS 3-S	54013	HM6147P-3
A1U58	1818-1596	7		IC CMOS 4096 (4K) STAT RAM 55-NS 3-S	54013	HM6147P-3
A1U59	1818-1596	7		IC CMOS 4096 (4K) STAT RAM 55-NS 3-S	54013	HM6147P-3
A1U60	1820-1677	0	1	IC FF TTL S D-TYPE OCTL	01295	SN74S74N
A1U61	1820-0629	0	1	IC FF TTL S J-K NEG-EDGE-TRIG	01295	SN74S112N
A1U62	1820-1077	4	1	IC MXR/DATA-SEL TTL S 2-TO-1-LINE QUAD	01295	SN74S157N
A1U63	1820-0693	8	3	IC FF TTL S D-TYPE POS-EDGE-TRIG	01295	SN74S74N
A1U64	1820-1052	5		IC XLTR ECL ECL-TO-TTL QUAD 2-INP	04713	MC10125L
A1U65	1810-0271	7		NETWORK-RES 10-SIP200.0 OHM X 9	01121	210A201
A1U66	1820-1944	4	1	IC LCH ECL D-TYPE POS-EDGE-TRIG DUAL	04713	MC10130L
A1U67	1820-0802	1		IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A1U68	1810-0271	7		NETWORK-RES 10-SIP200.0 OHM X 9	01121	210A201
A1U69	1820-1400	7	1	IC GATE ECL AND QUAD 2-INP	04713	MC10104P
A1U70	1810-0272	8		NETWORK-RES 10-SIP330.0 OHM X 9	01121	210A331
A1U71	1820-2193	7		IC FF ECL D-M/S POS-EDGE-TRIG COM CLOCK	04713	MC10126L
A1U72	1810-0272	8		NETWORK-RES 10-SIP330.0 OHM X 9	01121	210A331
A1U73	1820-2193	7		IC FF ECL D-M/S POS-EDGE-TRIG COM CLOCK	04713	MC10126L
A1U74	1820-0817	8		IC FF ECL D-M/S DUAL	04713	MC10131P
A1U75	1810-0200	8	1	NETWORK-RES 10-SIP10.0K OHM X 9	01121	210A103
A1U76	1820-1641	8	1	IC DRVR TTL LS BUS DRVR HEX 1-INP	01295	SN74LS365AN
A1U77	1816-1308	5	1	IC TTL L 1024 (1K) STAT RAM 75-NS 3-S	07263	93L422PC
A1U78	1820-1430	3	2	IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS161AN
A1U79	64601-10002	0	1	IC-7611A- 5-FORMAT	28480	64601-10002
A1U80	64601-10001	9	1	ROM-PROGRAMMED 5-CHAR	28480	64601-10001
A1U81	1820-1076	3	1	IC FF TTL S D-TYPE POS-EDGE-TRIG CLEAR	01295	SN74S174N
A1U82	1820-1197	9	1	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A1U83	1820-1158	2	1	IC GATE TTL S AND-OR-INV DUAL 2-INP	01295	SN74S51N
A1U84	1820-0693	8		IC FF TTL S D-TYPE POS-EDGE-TRIG	01295	SN74S74N
A1U85	1820-1917	1	1	IC BFR TTL LS LINE DRVR OCTL	01295	SN74LS240N
A1U86	1820-1173	1	1	IC XLTR ECL TTL-T8-ECL QUAD 2-INP	04713	MC10124L
A1U87	1810-0272	0		NETWORK-RES 10-SIP330.0 OHM X 9	01121	210A331
A1U88	1820-1322	2	1	IC GATE TTL S NOR QUAD 2-INP	01295	SN74S02N
A1U89	1820-0269	4	1	IC GATE TTL NAND QUAD 2-INP	01295	SN7403N
A1U90	1820-2799	9	1	IC-SN74LS259	28480	1820-2799
A1U91	1820-1216	3	1	IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A1U92	1820-1196	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74S174N
A1U93	1820-1196	9		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
A1U94	1820-1475	6	2	IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	07263	93S16DC
A1U95	1820-1475	6		IC CNTR TTL S BIN SYNCHRO POS-EDGE-TRIG	07263	93S16DC
A1U96	1820-1430	3		IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS161AN
A1U97	1820-1451	8	1	IC GATE TTL S NAND QUAD 2-INP	01295	SN74S38N
A1U98	1820-1191	3	1	IC FF TTL S D-TYPE POS-EDGE-TRIG COM	01295	SN74S175N
A1U99	1820-0686	9	1	IC GATE TTL S AND TPL 3-INP	01295	SN74S11N
A1U100	1820-0693	0		IC FF TTL S D-TYPE POS-EDGE-TRIG	01295	SN74S74N
A1U101	1820-0683	6	1	IC INV TTL S HEX 1-INP	01295	SN74S04N
A1XU1	1200-0541	1	4	SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A1XU13	1200-0607	0	22	SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0607
A1XU17	1200-0607	0		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0607
A1XU19	1200-0607	0		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0607
A1XU21	1200-0607	0		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0607
A1XU22	1200-0607	0		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0607
A1XU28	1200-0639	8	3	SOCKET-IC 20-CONT DIP DIP-SLDR	28480	1200-0639
A1XU31	1200-0607	0		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0607
A1XU32	1200-0630	7	7	SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0638
A1XU36	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A1XU37	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A1XU38	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A1XU44	1200-0639	8		SOCKET-IC 20-CONT DIP DIP-SLDR	28480	1200-0639
A1XU46	1200-0607	0		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0607
A1XU47	1200-0638	7		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0638
A1XU48	1200-0607	0		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0607
A1XU54	1200-0607	0		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0607
A1XU55	1200-0607	0		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0607
A1XU56	1200-0607	0		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0607
A1XU57	1200-0539	7	3	SOCKET-IC 18-CONT DIP DIP-SLDR	28480	1200-0539

See introduction to this section for ordering information

\*Indicates factory selected value

Replaceable Parts - Model 64601A

Table 6-2. Replaceable Parts List (Con't)

Reference Designation	HP Part Number	c D	Qty	Description	Mfr Code	Mfr Part Number
A1XU58	1200-0539	7		SOCKET-IC 18-CONT DIP DIP-SLDR	28480	1200-0539
A1XU59	1200-0539	7		SOCKET-IC 18-CONT DIP DIP-SLDR	28480	1200-0539
A1XU76	1200-0607	0		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0607
A1XU77	1200-0612	7	1	SOCKET-IC 22-CONT DIP DIP-SLDR	28480	1200-0612
A1XU78	1200-0607	0		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0607
A1XU79	1200-0607	0		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0607
A1XU80	1200-0607	0		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0607
A1XU84	1200-0638	7		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0638
A1XU85	1200-0639	8		SOCKET-IC 20-CONT DIP DIP-SLDR	28480	1200-0639
A1XU88	1200-0638	7		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0638
A1XU89	1200-0638	7		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0638
A1XU90	1200-0607	0		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0607
A1XU91	1200-0607	0		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0607
A1XU92	1200-0607	0		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0607
A1XU93	1200-0607	0		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0607
A1XU94	1200-0607	0		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0607
A1XU95	1200-0607	0		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0607
A1XU96	1200-0607	0		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0607
A1XU97	1200-0638	7		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0638
A1XU101	1200-0638	7		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0638
A1Y1	0410-1335	7	1	CRYSTAL-200MC	28480	0410-1335
W1	64600-61602	2	1	CABLE TIMING-2 CONNECTOR	28480	64600-61602
W2	64600-61603	3	1	CABLE TIMING-3 CONNECTOR	28480	64600-61603
W3	64620-61620	8	1	CABLE-ASYNCHRONOUS INTER-MODULE	20400	64620-61620

See introduction to this section for ordering information

\*Indicates factory selected value

Table 6-3. List of Manufacturers' Codes

Mfr No.	Manufacturer Name	Address	Zip Code
S0167	FUJITSU LTD	TOKYO	
S4013	HITACHI	TOKYO	JP
00000	ANY SATISFACTORY SUPPLIER		
01121	ALLEN-BRADLEY CO	MILWAUKEE WI	53204
01295	TEXAS INSTR INC SEMICOND CMPNT DIV	DALLAS TX	75222
02111	SPECTROL ELECTRONICS CORP	CITY OF IND CA	91745
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX AZ	85008
07263	FAIRCHILD SEMICONDUCTOR DIV	MOUNTAIN VIEW CA	94042
11236	CIS OF BERNE INC	BERNE IN	46711
19701	MEPCO/ELECTRA CORP	MINERAL WILLS TX	76057
20932	EMCON DIV ITW	SAN DIEGO CA	92129
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD PA	16701
25403	AMPEREX ELEK CORP SEMICON & MC DIV	SLATERSVILLE RI	02876
27014	NATIONAL SEMICONDUCTOR CORP	SANTA CLARA CA	95051
27167	CORNING GLASS WORKS (WILMINGTON)	WILMINGTON NC	28401
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO CA	94304
3L585	RCA CORP SOLID STATE DIV	SOMERVILLE NJ	
34335	ADVANCED MICRO DEVICES INC	SUNNYVALF CA	94086
S2763	SIETTNER-TRUSH INC	CAZENOVIA NY	13035
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS MA	01247
72136	ELECTRO MOTIVE CORP	FLORENCE SC	06726
75042	TRW INC PHILADELPHIA DIV	PHLADELPHIA PA	19108

See introduction to this section for ordering information

**Replaceable Parts - Model 64601A**

**NOTES**

SECTION VII

MANUAL CHANGES

This section normally contains information for backdating this manual for models with repair numbers prior to the one shown on the title page. Because this edition includes the information for the first repair number, there is no backdating material.

**Manual Changes - Model 64601A**

**NOTES**

## SECTION VIII

### THEORY AND SCHEMATICS

8-1. INTRODUCTION.

8-2. This section contains block diagrams, theory of operation, mnemonic tables, and schematics. Some theory of operation is also given in SECTION 4.

8-3. LOGIC CONVENTION

8-4. Logic states are defined as follows:

0-----False, negated, inactive, or unasserted state.

1-----True, active, or asserted state.

8-5. Voltage levels representing logic states:

LOW (L)-----The more negative of two voltage levels.

HIGH (H)-----The more positive of two voltage levels.

8-6. Signals may be either high true, or low true, as indicated by the mnemonics on the service sheets.

8-7. The 64601A includes both TTL and ECL ICs. Worst case voltage levels for trouble shooting and signature analysis purposes are as follows: (IC data sheet specifications may be better than this).

TTL Voltage Levels		ECL Voltage Levels	
Level	Voltage	Level	Voltage
LOW	<0.8	LOW	<-1.50
HIGH	>2.0	HIGH	>-1.10

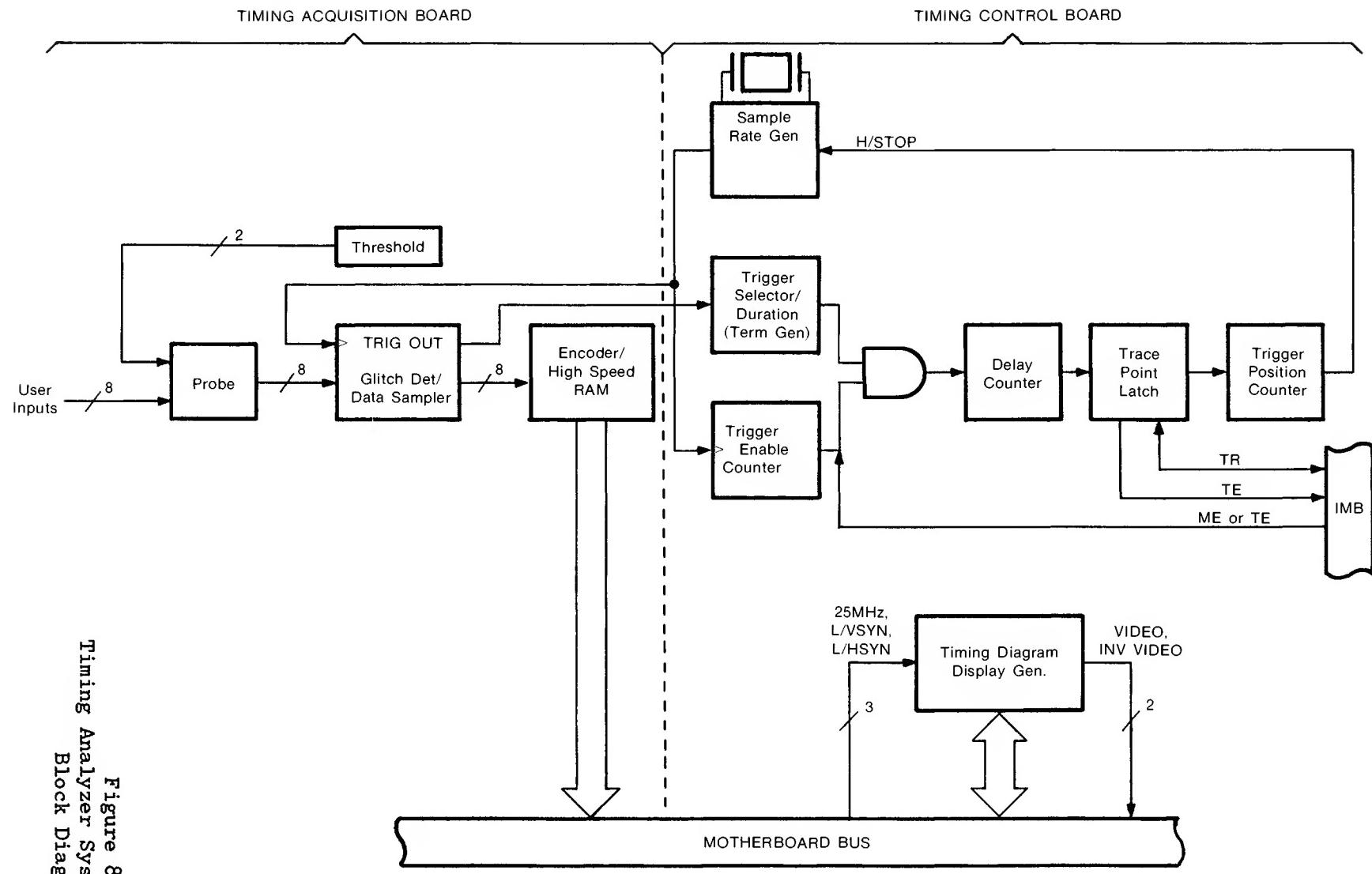


Figure 8-1.  
Timing Analyzer System  
Block Diagram

## 8-8. TIMING SYSTEM THEORY. (Fig. 8-1)

8-9. The timing analyzer consists of either two or three boards. In an 8-channel system there is one 8-channel acquisition board and one control board in the next higher mainframe slot. One timing probe is connected to each acquisition board.

8-10. The D/A converters on the acquisition board set the probe thresholds. The upper four channels can be programmed with an upper threshold, and the lower four channels with a lower threshold for dual threshold operation.

8-11. The eight inputs go into the probe, and after conditioning are sent out as 16 differential inputs to the acquisition board. The 16 inputs go into a "glitch" custom IC, along with four sample clocks, which determine the rate at which the acquisition board looks at data from the probe. Except for Glitch Mode, the triggering is asynchronous. The glitch chip's holding register has been programmed with the specified pattern during RESET, and will cause a trigger only when the incoming pattern agrees with the one specified. The glitch chip also looks for glitches in the glitch mode, and will cause a trigger if the glitch occurs at the time specified.

8-12. In a timing analysis system, the incoming data is constantly being stored in memory, regardless of whether a trigger has occurred. The encoders serialize the high-speed data so it may be loaded into low-speed RAM.

8-13. When the glitch chip recognizes that incoming pattern is the same as what was previously programmed into its holding register, it sends a trigger to the control board via the timing bus, which connects the control board to the acquisition board.

8-14. A trigger selector (U13,17) determines which acquisition board signal may become the trigger. Triggers may be ANDed or ORed. Durations or transitions may also be specified. If the trigger signal satisfies the qualifications at this point, and if the trigger has been enabled, either internally, or externally via the IMB from another analyzer, the trigger will be sent on to the delay counter.

8-15. The delay counter (U37) may be programmed to cause a delay from the time a trigger has come out of the glitch chip until the start of an actual trace in memory. Memory is continuously be filled, but "good" data does not occur until tracepoint (trigger + delay) has occurred. The delay counter is clocked internally by the sample clock, or externally from the IMB (DLCK) if the delay must be synchronous.

8-16. The programmable delay counter sends its terminal count to a tracepoint latch (U51). The tracepoint latch may be loaded either by the internal trigger signal, or by a trigger from another analyzer via the IMB.

8-17. The tracepoint signal now goes to the programmable window, or trigger position counter (U36), which determines how much post-tracepoint memory will be filled. The window counter's terminal count stops the sample clock and the memory address counters on the acquisition board. By determining the size of the window between tracepoint and end-of-acquisition, the window counter determines the position of tracepoint in memory.

## Theory and Schematics - Model 64601A

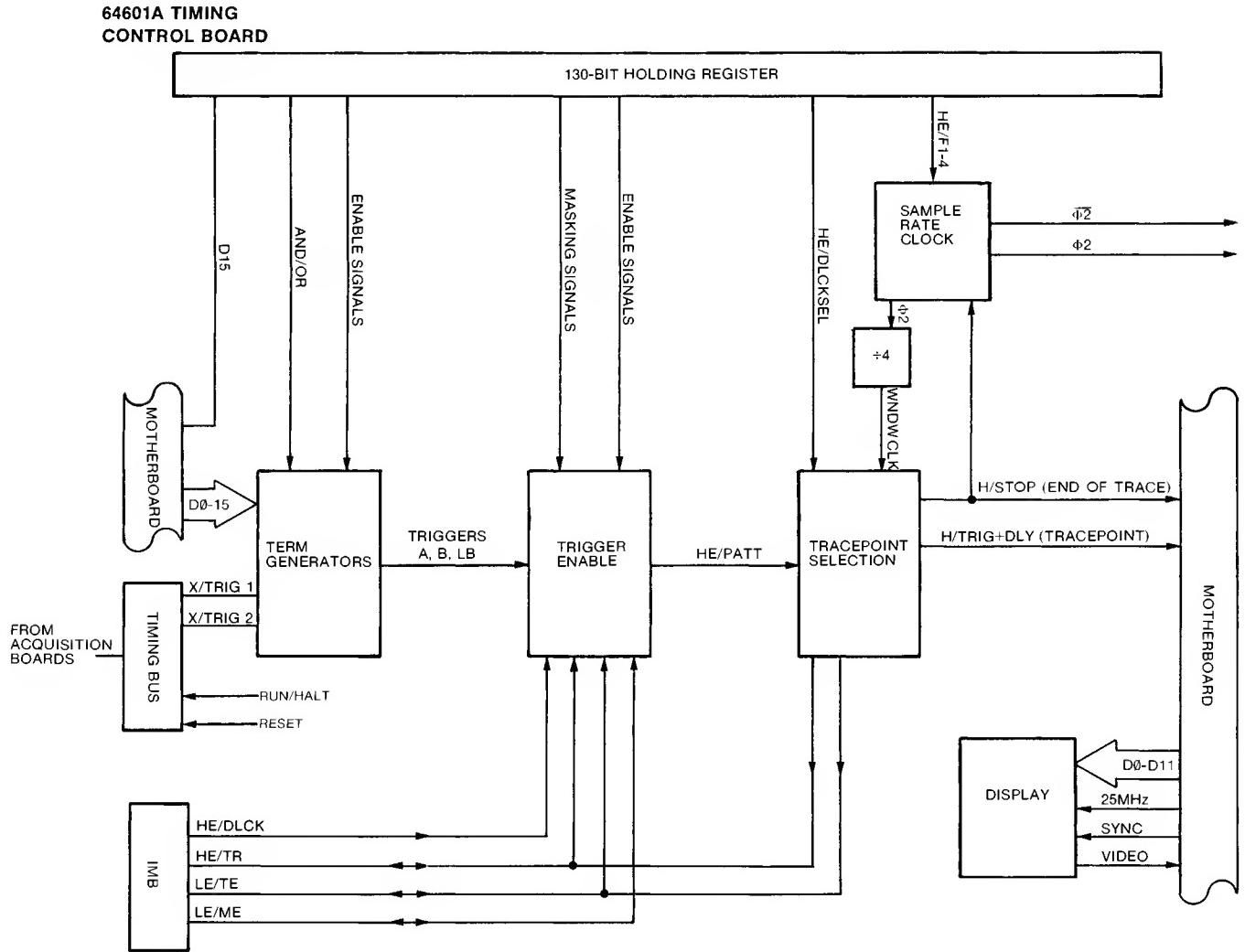


Figure 8-2.  
Timing Control Board  
Block Diagram

8-18. TIMING CONTROL BOARD THEORY. (Fig. 8-2)

8-19. 130-Bit Control Holding Register.

8-20. The CPU programs the timing analyzer by loading 130 bits into a holding register, consisting of the 25-bit registers in U1, 36, 37, 38, and the 6-bit registers U10, 11, 15, 71, and 73. The analyzer can be programmed to AND or OR triggers from two acquisition boards, sample at different rates up to 400MHz, generate and combine up to two terms, trigger on entering or leaving pattern transitions, trigger on maximum or minimum pattern durations, or delay for specified times after triggering.

8-21. IMB (Inter Module Bus).

8-22. The IMB is the means by which the timing analyzer communicates with other analyzers, such as a state analyzer. The timing analyzer can be clocked, or triggered, or enabled externally. It can also enable, delay, or trigger another analyzer.

8-23. Timing Bus.

8-24. The timing bus is the means by which the control board communicates with one or two timing acquisition boards. The control board sends the acquisition board sample clocks and RESET and RUN commands; the acquisition board(s) sends the control board a trigger signal when the specified pattern is found and memory has been filled.

8-25. Motherboard.

8-26. The motherboard is the mainframe bus which communicates power and CPU programming signals to the timing analyzer.

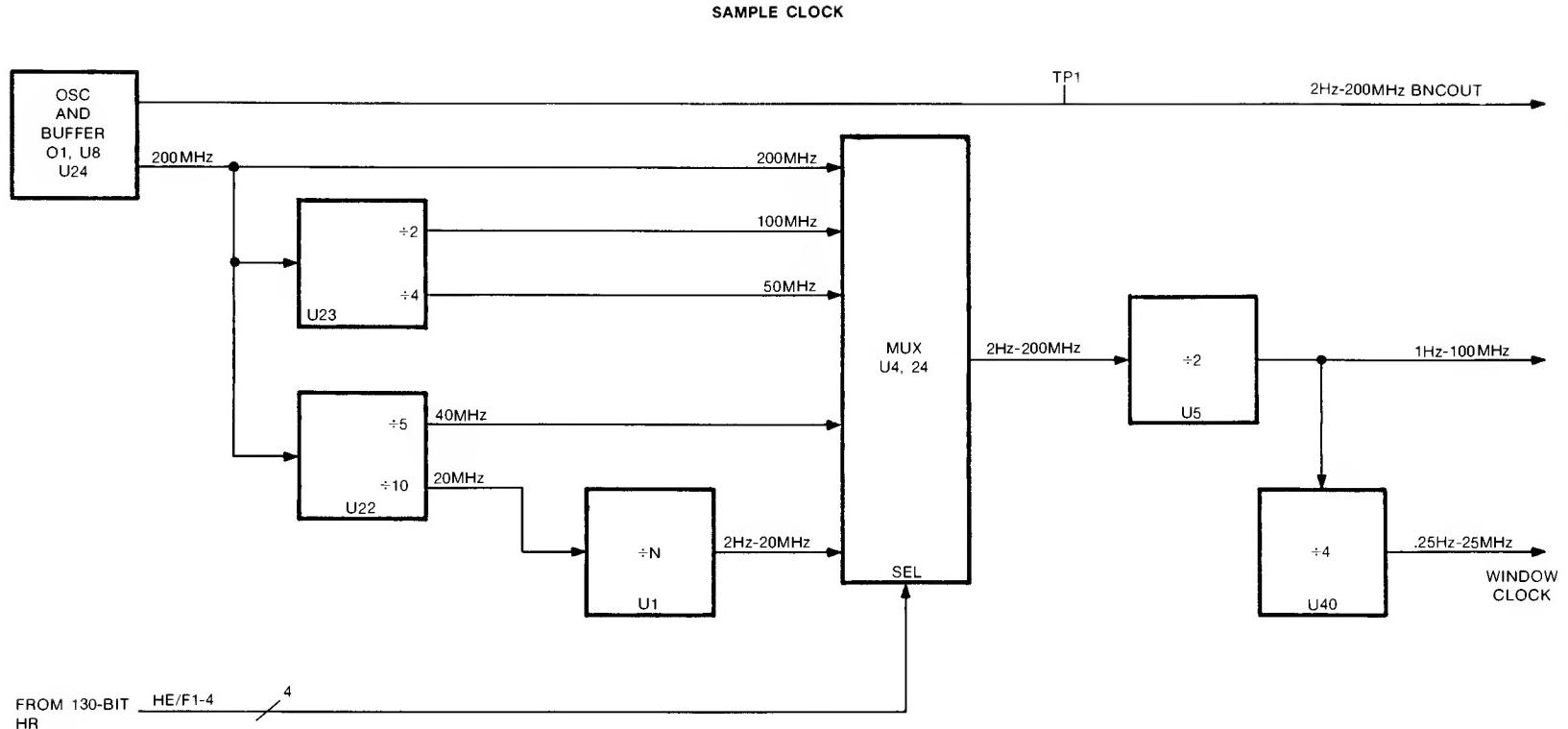


Figure 8-3.  
Sample Rate Clock  
Block Diagram

## 8-27. SAMPLE RATE CLOCK THEORY. (Figs. 8-3, 8-10)

8-28. The sample rate clock determines the frequency at which the timing analyzer samples data. The maximum clock frequency is 100MHz, but data is sampled on both clock edges, allowing a maximum sample rate of 200MHz in the Wide Sample Mode.

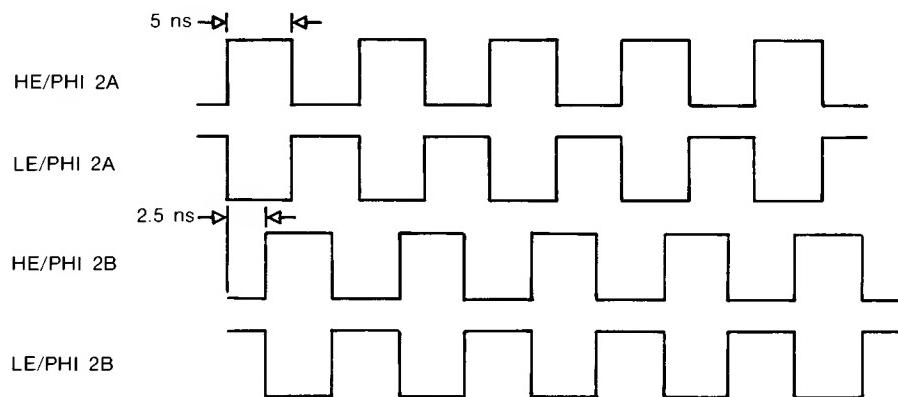
8-29. In Fast Sample Mode the clock is split into two phases, allowing four edges in the same time period, thus effectively increasing the sample rate to 400MHz. In the Fast Sample Mode the number of channels in an eight channel system is decreased from eight to four, since every second channel is sampled at the second clock phase.

## SAMPLE CLOCKS

## NORMAL, GLITCH, &amp; D.T. MODES



## FAST SAMPLE (400 MHz) MODE



## NOTE:

DATA FROM THE PROBE IS SAMPLED ON BOTH THE RISING & FALLING EDGE OF EACH CLOCK SIGNAL.

Figure 8-4. Sample Clock Waveforms

## Theory and Schematics - Model 64601A

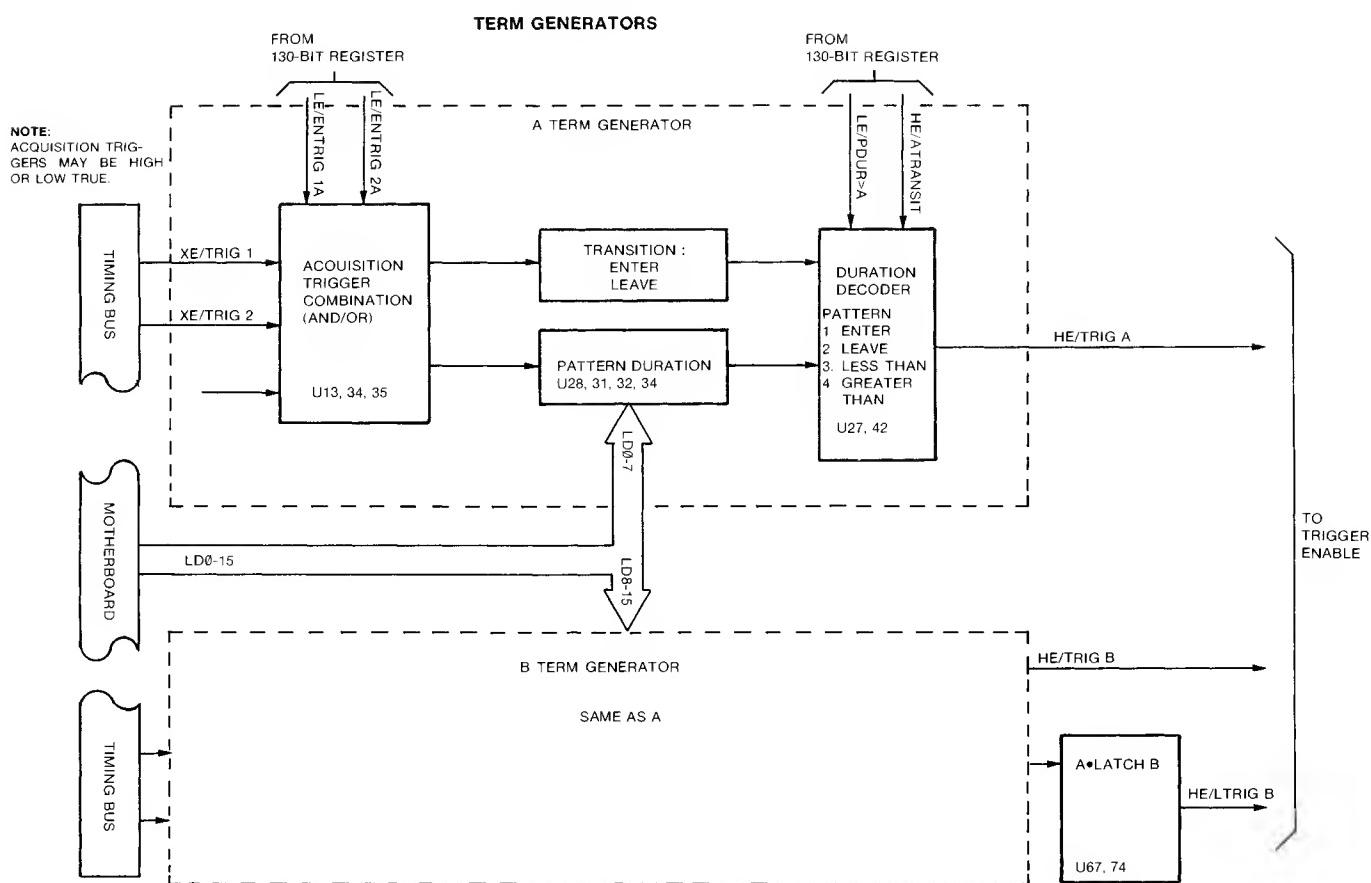


Figure 8-5.  
Term Generators  
Block Diagram

## 8-30. TERM GENERATORS. (Figs. 8-4, 8-11, 8-12)

8-31. The term generators receive, combine, and qualify the trigger(s) from the acquisition board(s). There are two term generators, A and B, on a timing control board. Thus, an A trigger, a B trigger, or a B-Latched-Then-A trigger signal may be generated. A and B terms may be ANDed, but the latched-B and B triggers are mutually exclusive.

8-32. The "A" term generator will be described. One of the outputs of the AND/OR trigger combination IC is a ramp moving down toward -5.2V (U35-3). The ramp moves down at a rate determined by the combination of capacitors and current sources turned on by the programming. At some point the ramp will reach the schmitt trigger (U34) threshold. The schmitt will thus trigger sooner or later, depending on the programmed duration.

8-33. The other output of the AND/OR trigger combination IC is a high-going pulse into the transition circuit (U27). One of the paths through U27 is delayed, so that when the pulse finally goes low again, a negative glitch occurs (U27-9).

8-34. When a trigger satisfies the conditions of the "A" term generator, the output (HE/TRIGA at U42-3) is a positive-going pulse. This output can occur under four different conditions:

- a. Greater-Than durations: The pattern must last longer than the A term generator specifies.
- b. Less-Than durations : The pattern must last less than the A term generator specifies.
- c. Leaving transitions : A trigger will occur when the pattern is leaving the specified pattern.
- d. Entering transitions : A trigger will occur when the input data is entering the specified pattern.

8-35. Three signals determine which of the above situations will cause an A trigger (HE/TRIGA). Tables for these signals are given on the service sheets for the term generators (4 and 5).

- a. XE/TRIG1 and XE/TRIG2 from the acquisition boards may be programmed to be either high true, or low true, at the output of the glitch chip. These signals are programmed low for entering transitions. For all other situations, they are high true.
- b. LE/PDUR>A (pattern duration greater than A specifies) is low, or true, only for greater-than durations.
- c. HE/TRANSITA is high, or true, only when transitions are specified.

8-36. In the B term generator, there is a latched B circuit, which allows a B trigger to be latched. Then, if an A trigger occurs afterwards, HE/LTRIGB will be true out of the B term generator. The latched-B trigger is mutually exclusive with the normal B trigger signal, HE/TRIGB.

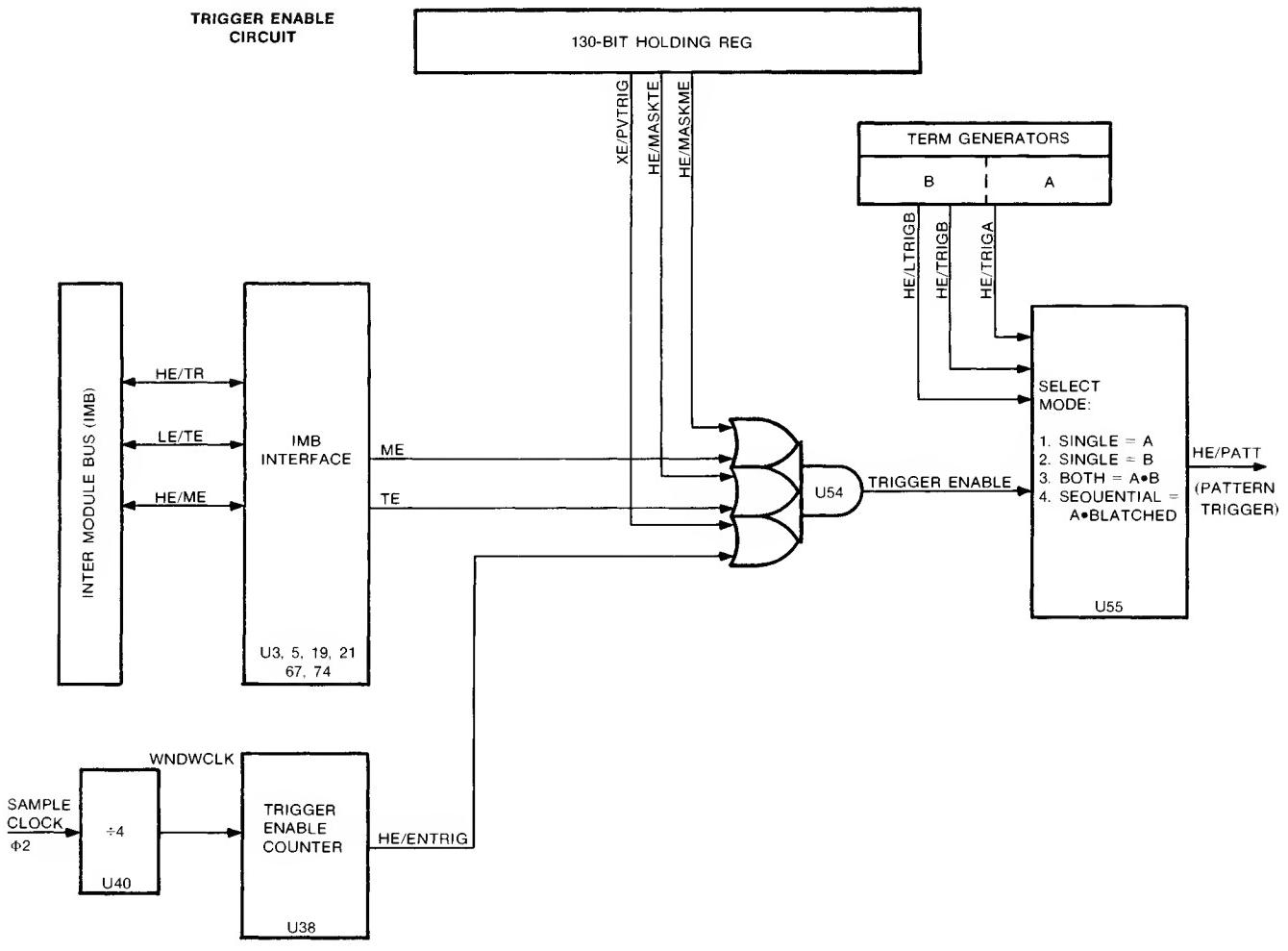


Figure 8-6.  
Trigger Enable Circuit  
Block Diagram

## 8-37. TRIGGER ENABLE CIRCUIT. (Figs. 8-5, 8-13)

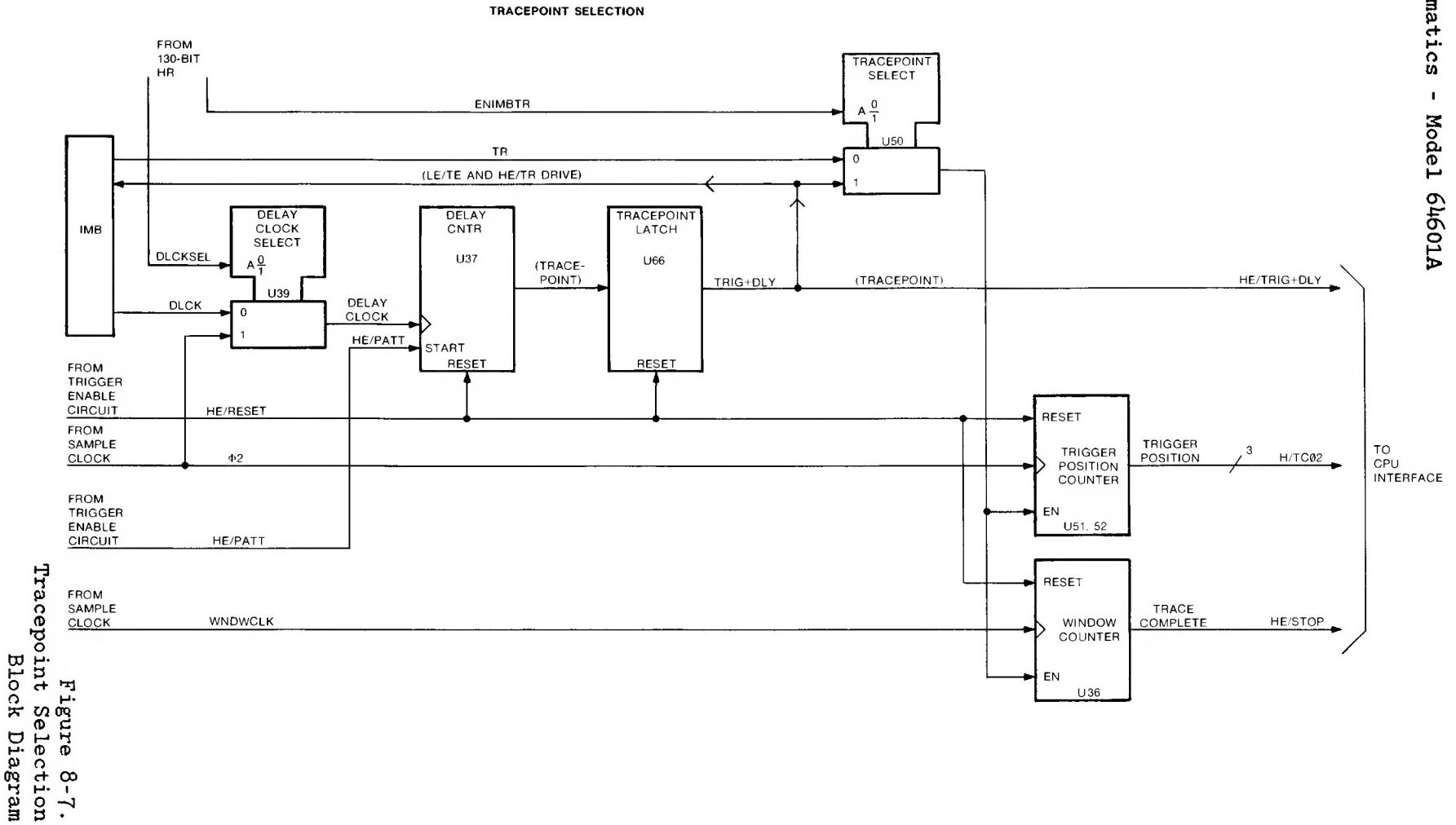
8-38. The trigger enable circuit receives the qualified A, B, or B-Latched signals from the term generators. The trigger enable circuit can combine these signals into a pattern trigger, HE/PATT; or it can form a trigger from external commands via the IMB.

8-39. The glitch chip and the encoders on the acquisition board are between the probe and memory. Before a new run they contain old data from the last run. The trigger enable counter (U38) is programmed to hold off a trigger for several clocks, until the old data has been flushed from the system. The trigger enable counter also allows a certain amount of pre-trigger information to be viewed, even in start-trace modes. Since the trigger enable counter and the window counter (U36) are not fast enough to be clocked at the sample rate, they are clocked by the window clock (U40), which is one-fourth the rate.

8-40. The trigger enable circuit may drive, and be driven by, the IMB. The timing analyzer can enable, or be enabled by, other analyzers. The trigger (TR), trigger enable (TE), or master enable (ME) lines from the Inter Module Bus may all be used to enable the timing analyzer. The timing analyzer may also itself drive the TR, TE, and ME lines.

8-41. The trigger enable circuit also has a Post-Qualify Mode. When the HE/RESTARTEN (restart enable) line is high, the IMB TE line acts as a restart line, causing the timing analyzer to reset itself at the command of a second analyzer and look for another trigger. The TE line acts like a restart line in this mode; and the TR line acts like a hold line, preventing further resets.

8-42. The trigger enable circuit determines which term generator trigger, HE/TRIGA, HE/TRIGB, or HE/LTRIGB will become the pattern trigger HE/PATT that is sent on to the delay counter. The latched B trigger and the B trigger are mutually exclusive, but the A and B triggers may be anded.



## 8-43. TRACEPOINT SELECTOR. (Figs. 8-6, 8-14)

8-44. "Tracepoint" is the start of a trace. The acquisition board provides a trigger signal to the control board when the pattern specification is satisfied. This trigger signal is further qualified in the control board: (1) It can be ANDed or ORed with a trigger from a second acquisition board. (2) It can be armed by signals from the IMB. (3) It can be delayed. (4) It can be qualified as to pattern duration and transition. The final qualified trigger (HE/TRIG+DLY) that starts a trace is called tracepoint.

8-45. The tracepoint selector receives the qualified pattern trigger, HE/PATT, from the Trigger Enable Circuit. The tracepoint selector can add delay to the timing trigger; or it can ignore the timing trigger entirely, and trigger the analyzer via the IMB.

8-46. The tracepoint selector is also programmed by the 130-bit holding register to determine the amount of "window" between tracepoint in memory and the end of new acquisition. That is, the tracepoint selector generates HE/STOP, which stops the sample clock, ending the trace.

8-47. The tracepoint selector allows the mainframe to determine the exact position of tracepoint in memory. This is necessary because the acquisition RAM is loaded from eight-bit serial-to-parallel shift registers. Thus the memory write pulses and the memory address counter clocks occur at one-eighth sample frequency. Without additional circuitry in the tracepoint selector, the position of the trigger in memory could be known only to an eight-bit-group accuracy.

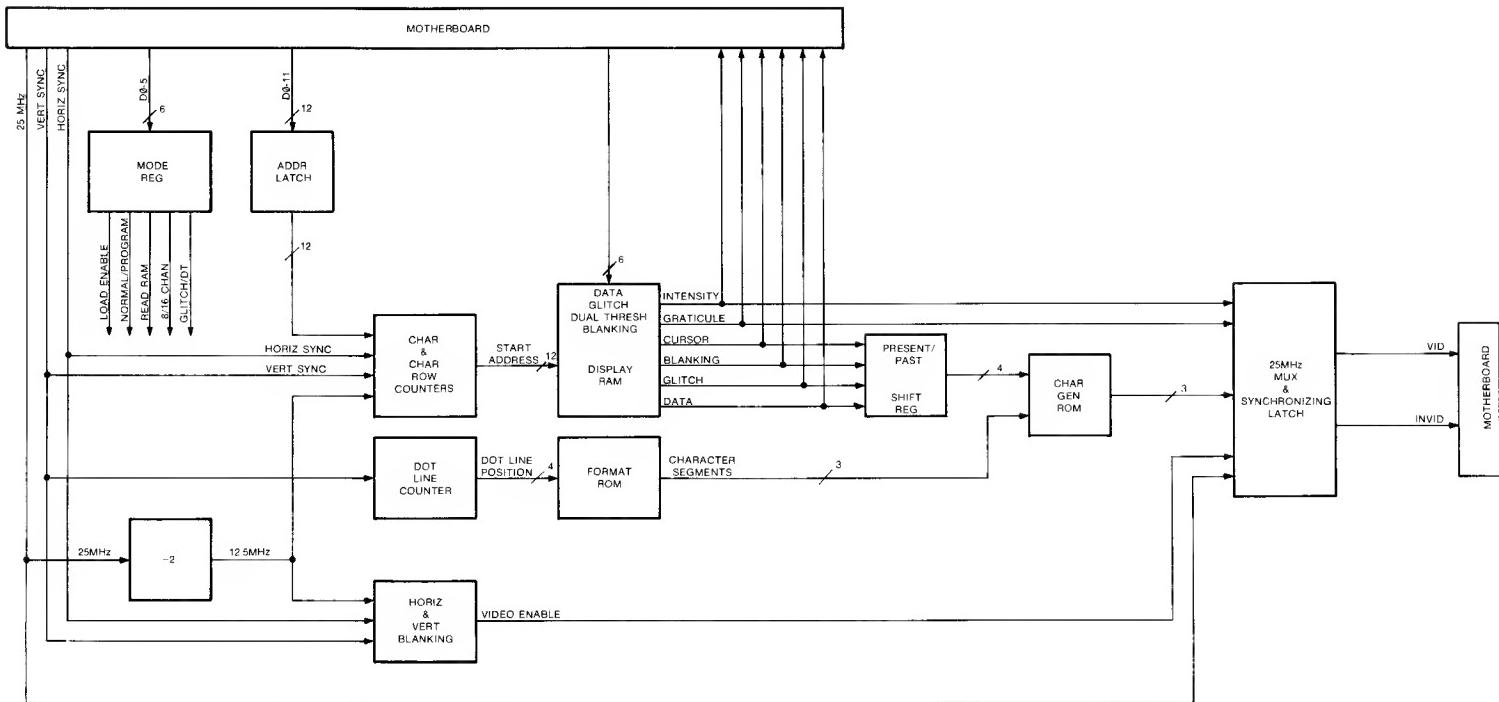


Figure 8-8.  
Display Driver  
Block Diagram

## 8-48. DISPLAY DRIVER. (Figs. 8-7, 8-15, 8-16)

8-49. The timing analyzer has its own display driver, which provides the timing characters, enhancements, and blanking to the mainframe for display. The mainframe receives the display driver video, programs the display to start at a particular portion of the screen, supplies horizontal and vertical synchronizing pulses, and selects the order and number of the probe channels displayed.

8-50. The display driver produces a 512-by-240 dot display. Each character is two dots wide; in the 8-channel mode a character is 30 dots high, and in the 16-channel mode 15 dots high.

8-51. The display driver has two modes of operation. In the programming mode the mainframe presets the character counter, the character-row counter, and the dot-line counter with starting addresses for the display. The mainframe also loads the display RAMs with data, glitch, blanking, cursor, intensify, and graticule information. In the normal mode, the timing analyzer actually sends video and inverse video to the mainframe for display.

8-52. The character counters are capable of counting 255 2-dot characters, but are preset to less to allow for a left margin. The dot-line counters count the number of horizontal dot-lines in the display. Since only one line of a character is written at a time, the dot-line counter increments each time horizontal sync (L/HSYN) pulses. The character-row counter counts the number of character rows (eight in 8-channel mode) and increments every 30 lines in 8-channel mode, or every 15 lines in 16-channel mode.

8-53. The mainframe loads the encoded timing information into the display RAMs during the programming mode. Since transitions require knowledge of past data, RAM information is sent to a "present/past" shift register, which delays data by one dot during display. Both old and new data are then sent to a character ROM, which also receives information from the formatting ROM. Since only one line of a character is written at a time, and characters such as dualthresholds have "middle" information, horizontal trace position is needed to format characters. The formatting ROM, after getting the horizontal position from the dot-line counter, outputs a 3-segment code which correlates horizontal position with character type.

8-54. The character ROM encodes data and formatting information into two dots of video. The mainframe writes dots on the screen at a 25MHz rate; but since each character is two dots wide, 12.5MHz has been used up to this point in the display driver. The two 12.5MHz parallel dots are therefore changed to serial information and synchronized with the 25MHz system clock in the output latch.

8-55. Since data, enhancements, and blanking have taken different paths, they need to be synchronized. The output latch "lines up" the information so that the data may be enhanced and blanked; and the resulting video is sent out to the mainframe.

8-56. MNEMONICS.

8-57. Mnemonics are listed in alphabetical order following the slash. The following convention is used:

- a. An L or H before the slash indicates active LOW or HIGH.
- b. An E after L or H, but before the slash, indicates an ECL signal.
- c. No E before the slash indicates a TTL signal.
- d. An X instead of L or H means the signal may be programmed as either active LOW or HIGH.
- e. The functional mnemonic appears after the slash.

Table 8-1. Mnemonics

MNEMONIC	DEFINITION
HE/AND	Determines AND/OR combination of XE/TRIG signals from two acquisition boards.
HE/ATRANSIT	A transition. Enables an A trigger on the transition "leaving" the specified pattern. To trigger on "entering" transitions, XE/TRIG from the acquisition board must be LOW true.
HE/BLATCHR	B latch reset. Resets B latch for B-Latched mode.
L/BLNKMEM	Enable display blanking memory.
HE/BTRANSIT	B transition. Enables a B trigger on the transition "leaving" the specified pattern. To trigger on "entering" transitions, XE/TRIG from the acquisition board must be LOW true.
H/CHARADO-11	Character address. Addresses to display RAM from the character and line counters.

<u>MNEMONIC</u>	<u>DEFINITION</u>
L/CNTRLD	Counter load. Clocks character, dot-line, and character-row counters in the display circuits during the programming mode. During normal counting, 12.5MHz clocks these counters. Derived from L/MEMWRT.
HE/DLCLK	Delay clock. The timing analyzer delay counter (U37) may be clocked externally over this IMB line.
L/DATAMEM	Enable display data memory.
HE/DLYCLKSEL	Delay clock select. Selects a clock for the delay counter (U37), which may be clocked internally or via the IMB.
L/D0-15	Data lines from motherboard.
HE/D15	Derived from data line 15. Programs the 130-bit register.
L/ENHANMEM	Enable display enhancement memory.
LE/ENDRIVME	Enables the timing analyzer to drive the IMB LE/ME (master enable) line true when a valid trigger occurs.
LE/ENDRIVTE	Enables the timing analyzer to drive the IMB LE/TE (trigger enable) line true when a valid trigger occurs.
LE/ENDRIVTR	Enables the timing analyzer to drive the IMB LE/TR (trigger) line true when a valid trigger occurs.
LE/ENIMBTR	Enable IMB trigger. Enables the IMB TR line to determine trace-point externally.
LE/ENLATCHB	Enables a latched B trigger. Causes a trigger if A occurs anytime following B.
LE/ENPVTRIG	Enables a performance verification trigger.
LE/ENTRIGA	Enables a trigger out of the A term generator.
LE/ENTRIGB	Enables a trigger out of the B term generator.
LE/ENTRIG1A	Enables a trigger into the A term generator from the acquisition board in the lower numbered slot.

Theory and Schematics - Model 64601A

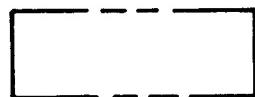
<u>MNEMONIC</u>	<u>DEFINITION</u>
LE/ENTRIG2A	Enables a trigger into the A term generator from a second acquisition board in the higher numbered slot.
LE/ENTRIG3A	Enables a trigger into the A term generator from a third acquisition board. Not used in a 200MHz system.
LE/ENTRIG4A	Enables a trigger into the A term generator from a fourth acquisition board. Not used in a 200MHz system.
LE/ENTRIG1B	Enables a trigger into the B term generator from the acquisition board in the lower numbered mainframe slot.
LE/ENTRIG2B	Enables a trigger into the B term generator from a second acquisition board in the higher numbered mainframe slot.
LE/ENTRIG3B	Enables a trigger into the B term generator from a third acquisition board. Not used on the 200MHz system.
LE/ENTRIG4B	Enables a trigger into the B term generator from a fourth acquisition board. Not used on the 200MHz system.
HE/F1 *	
HE/F2 *	Selects the sample clock frequency.
HE/F3 *	
HE/F4 *	
L/GLTCHMEM	Enable display glitch memory.
HE/HRCLK	Holding register clock. Clocks programming into the 130-bit control register.
L/HSYN	Horizontal synchronizing signal for display from the mainframe.
L/IVID	Inverse video to motherboard.
L/LOADEN	Load enable. Enables presetting the display counters with an address for the display RAMs during the programming mode.
L/LOADUR	Load duration. Clocks in pattern duration specification.
HE/LTRIGB	Latched B trigger signal. HE/TRIGB must be false. A trigger will occur when A occurs anytime after B.
HE/MASKME	Mask master enable. Masks the IMB master enable signal. Must be low if ME from the IMB is to enable the trigger.

<u>MNEMONIC</u>	<u>DEFINITION</u>
HE/MASKTE	Mask trigger enable. Masks the IMB trigger enable signal. Must be low if TE from the IMB is to enable the trigger.
H/MEMFUL	Memory full. Indicates when memory has been completely filled with good data at least once. Status bit to processor.
L/MEMWRT	Enables write to display memory.
L/MODEN	Mode enable. Enables display mode register.
HE/PATT	Pattern trigger. Internal trigger signal after being qualified by term generators, but before delay is inserted. External trigger may also be asserted at this point.
H/PATTOUT(BNC4)	Pattern trigger output to the BNC4 jack on the mainframe.
LE/PDUR>A	Pattern duration greater than A specifies. Enables triggering on patterns with durations greater than specified by the A term generator. High for "less than" durations.
LE/PDUR>B	Pattern duration greater than B specifies. Enables detection of patterns with durations greater than specified by the B term generator. False, or high, for "less-than" widths.
HE/phi2C1	Derived from phi2 sample clock. Used to clock the delay counter if HE/DLCLK (delay) from the IMB is not selected.
HE/phi2C2	Derived from phi2 sample clock. Clocks the position counter, which determines exact trigger position in an eight-bit sample group. Also used to derive H/WNDWCLK for the window and trigger enable counters.
HE/phi2,	Sample clock from sample rate generator to the acquisition boards.
L/PROGRAM	Selects programming mode for timing display. This mode is used for loading the display RAMs. When high, the display, or normal, mode is selected.
LE/PVCLK	Performance verification sample clock from the mainframe.
HE/PVSTOP	Stops the sample clock during performance verification.

<u>MNEMONIC</u>	<u>DEFINITION</u>
XE/PVTRIG	Used instead of a acquisition-board trigger during performance verification. Can be either HIGH or LOW, depending on whether ANDing or ORing triggers.
L/POP	Power-on-pulse from motherboard.
HE/PROCRESET	Processor reset. Used by the mainframe to drive HE/RESET.
H/RCNTR0-3	Row counter output. Addresses to the Character-Row RAM.
HE/RESET	Master reset or initialization.
HE/RESTARTEN	Enables a restart on receipt of a high-going LE/TE transition from the IMB. Sets the Post-Qualify mode, which allows LE/TE to act like a restart signal.
LE/RUN	Enables run mode. When high, stops the sample clock.
HE/RUN	Enables run mode on the acquisition board via the timing bus.
H/SCLKOUT(BNC3)	Sample clock output before the last divider. Output to a BNC connector.
L/STARTADR	Start address. Clocks in the starting address for the display.
HE/STOP	Stops acquisition. Window counter (U36) output, which determines the position of the trigger in memory (ie, the window in memory between tracepoint and the end-of-acquisition).
H/TC0, H/TC1, H/TC2	Trigger position count. Determine the exact trigger position within an eight-sample clock group. Status bits to mainframe.
LE/TEARM	Trigger enable arm. Will arm the trigger when L/TE from the IMB is true.
LE/TEDRIVE	Trigger enable drive. Signal used by the timing analyzer to drive the IMB LE/TE (trigger enable) line.
HE/TR	Trigger. The timing analyser can be triggered, or can assert a trigger on this IMB line.
HE/TRDRIVE	Trigger drive. Signal used by the timing analyzer to drive the IMB HE/TR (trigger) line.

<u>MNEMONIC</u>	<u>DEFINITION</u>
LE/TRDRVTE	Trigger drives trigger enable. The received HE/TR from the IMB is used to drive the IMB LE/TE line.
HE/TRIGTEST	Enables trigger for performance verification.
HE/TRIGA	Trigger signal qualified by the A term generator.
HE/TRIGB	Trigger signal qualified by the B term generator.
H/TRIG+DLY	Trigger plus delay. Tracepoint--the position of the trigger in memory, plus any delay added by the timing analyzer's delay counter or by another analyzer via the IMB.
L/VID	Video from display driver to motherboard.
L/VSYN	Vertical synchronizing signal for display from the mainframe.
HE/WNDWCLK	Window clock. Clock to window (U36) and trigger enable (U38) counters.
H/12.5MHz, L/12.5MHz	Derived from the 25MHz. mainframe system clock. Used as the timing display character clock, since each timing character is two dots wide.
25MHz CLK	Mainframe system clock. Used by the timing display as the dot frequency.

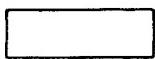
NOTES



ETCHED CIRCUIT BOARD

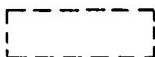
(925)

WIRE COLORS ARE GIVEN  
BY NUMBERS IN PARENTHESES  
USING THE RESISTOR COLOR  
CODE



FRONT PANEL MARKING

[ (925) IS WHT-RED-GRN ]  
0 - BLACK      5 - GREEN  
1 - BROWN      6 - BLUE  
2 - RED      7 - VIOLET  
3 - ORANGE      8 - GRAY  
4 - YELLOW      9 - WHITE



REAR-PANEL MARKING



MANUAL CONTROL

\*      OPTIMUM VALUE SELECTED  
AT FACTORY, TYPICAL  
VALUE SHOWN; PART MAY  
HAVE BEEN OMITTED.



SCREWDRIVER ADJUSTMENT



TP1      ELECTRICAL TEST POINT  
TP (WITH NUMBER)

UNLESS OTHERWISE INDICATED:  
RESISTANCE IN OHMS  
CAPACITANCE IN PICOFARADS  
INDUCTANCE IN MICROHENRIES



NUMBERED WAVEFORM  
NUMBER CORRESPONDS TO  
ELECTRICAL TEST POINT NO.

$\mu$ P = MICROPROCESSOR

P/O = PART OF

NC = NO CONNECTION



LETTERED TEST POINT  
NO MEASUREMENT AID  
PROVIDED

CW = CLOCKWISE END OF VARIABLE  
RESISTOR



COMMON CONNECTIONS. ALL LIKE-DESIGNATED POINTS ARE CONNECTED.



NUMBER ON WHITE BACKGROUND = OFF-PAGE CONNECTION.  
LARGE NUMBER ADJACENT = SERVICE SHEET NUMBER FOR OFF-PAGE CONNECTION.



CIRCLED LETTER = OFF-PAGE CONNECTION BETWEEN PAGES OF SAME SERVICE  
SHEET.

— INDICATES SINGLE SIGNAL LINE

NUMBER OF LINES ON A BUS

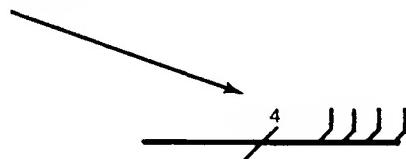


Table 8-2. Logic Symbols

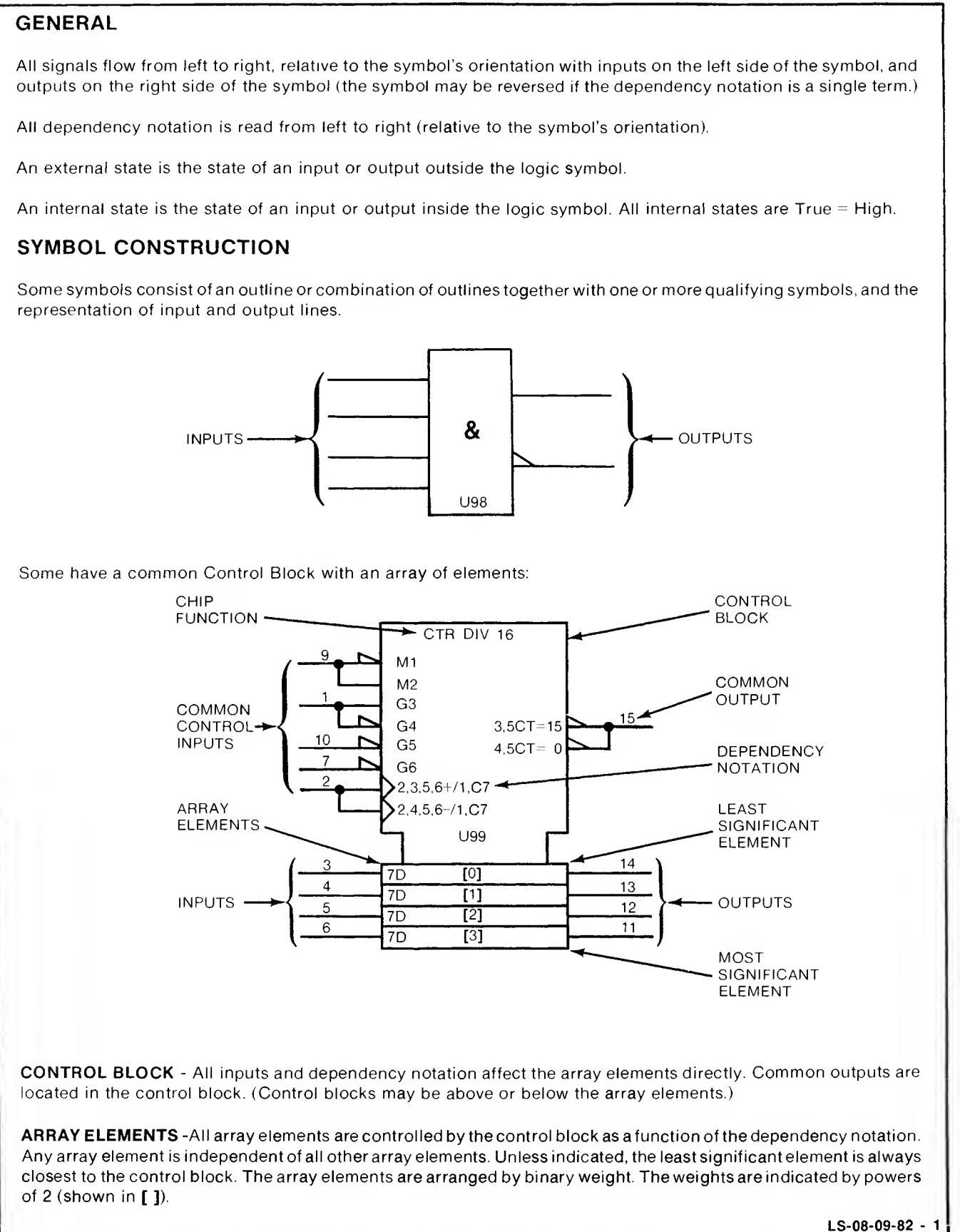


Table 8-2. Logic Symbols (Cont'd)

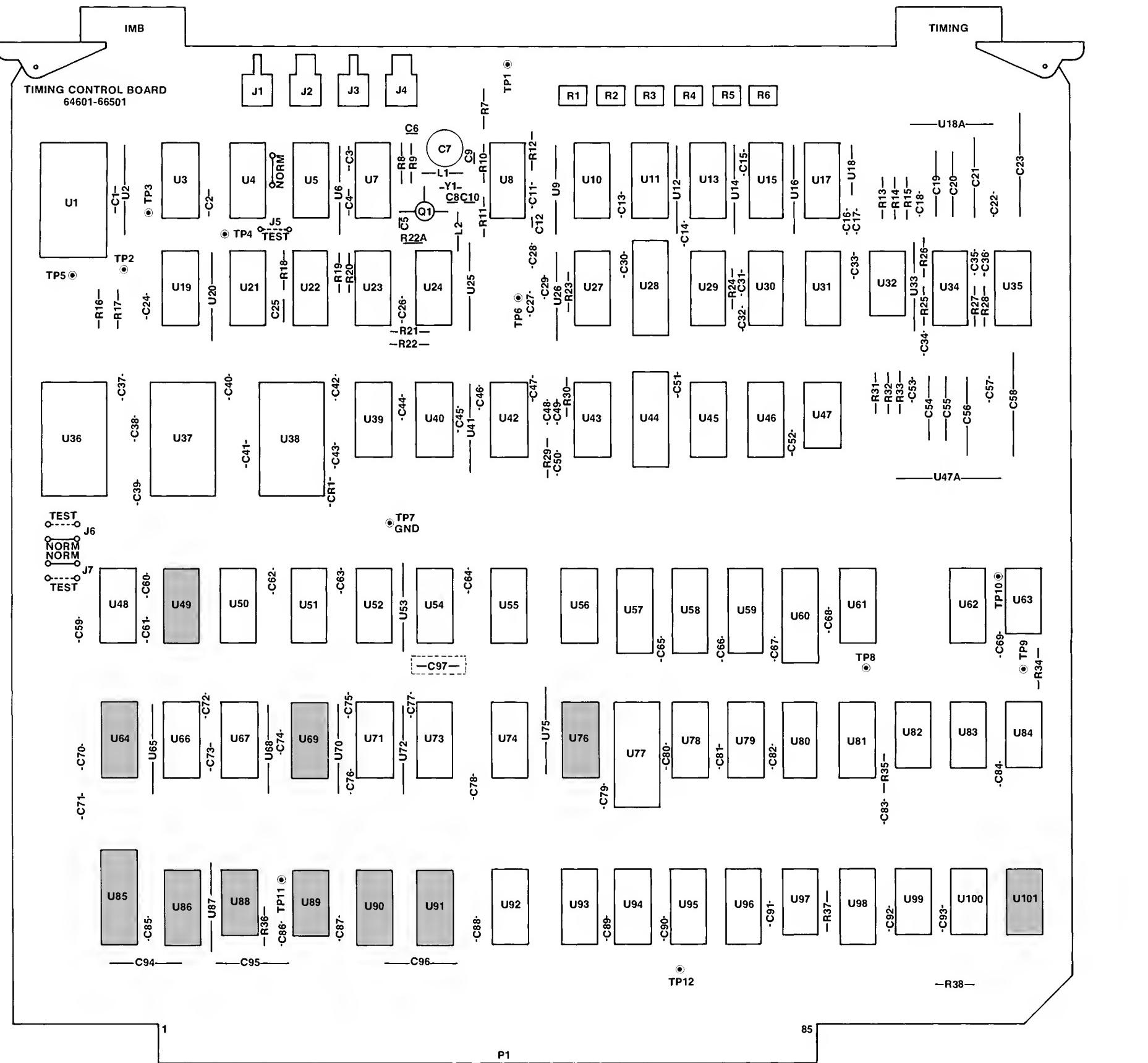
<b>INPUTS</b> - Inputs are located on the left side of the symbol and are affected by their dependency notation.	
Common control inputs are located in the control block and control the inputs/outputs to the array elements according to the dependency notation.	
Inputs to the array elements are located with the corresponding array element with the least significant element closest to the control block.	
<b>OUTPUTS</b> - Outputs are located on the right side of the symbol and are effected by their dependency notation.	
Common control outputs are located in the control block.	
Outputs of array elements are located in the corresponding array element with the least significant bit closest to the control block.	
<b>CHIP FUNCTION</b> - The labels for chip functions are defined, i.e., CTR - counter, MUX - multiplexer.	
<b>DEPENDENCY NOTATION</b>	
Dependency notation is always read from left to right relative to the symbol's orientation.	
Dependency notation indicates the relationship between inputs, outputs, or inputs and outputs. Signals having a common relationship will have a common number, i.e., C7 and 7D...C7 controls D. Dependency notation 2,3,5,6+1,C7 is read as when 2 and 3 and 5 and 6 are true, the input will cause the counter to increment by one count...or (/) the input (C7) will control the loading of the input value (7D) into the D flip-flops.	
The following types of dependencies are defined:	
a. AND (G), OR (V), and Negate (N) denote Boolean relationship between inputs and outputs in any combination.  b. Interconnection (Z) indicates connections inside the symbol.  c. Control (C) identifies a timing input or a clock input of a sequential element and indicates which inputs are controlled by it.  d. Set (S) and Reset (R) specify the internal logic states (outputs) of an RS bistable element when the R or S input stands at its internal 1 state.  e. Enable (EN) identifies an enable input and indicates which inputs and outputs are controlled by it (which outputs can be in their high impedance state).  f. Mode (M) identifies an input that selects the mode of operation of an element and indicates the inputs and outputs depending on that mode.  g. Address (A) identifies the address inputs.  h. Transmission (X) identifies bi-directional inputs and outputs that are connected together when the transmission input is true.	
<b>DEPENDENCY NOTATION SYMBOLS</b>	
A	Address (selects inputs/outputs) (indicates binary range)
C	Control (permits action)
EN	Enable (permits action)
G	AND (permits action)
M	Mode (selects action)
N	Negate (compliments state)
R	Reset Input
S	Set Input
V	OR (permits action)
Z	Interconnection
X	Transmission

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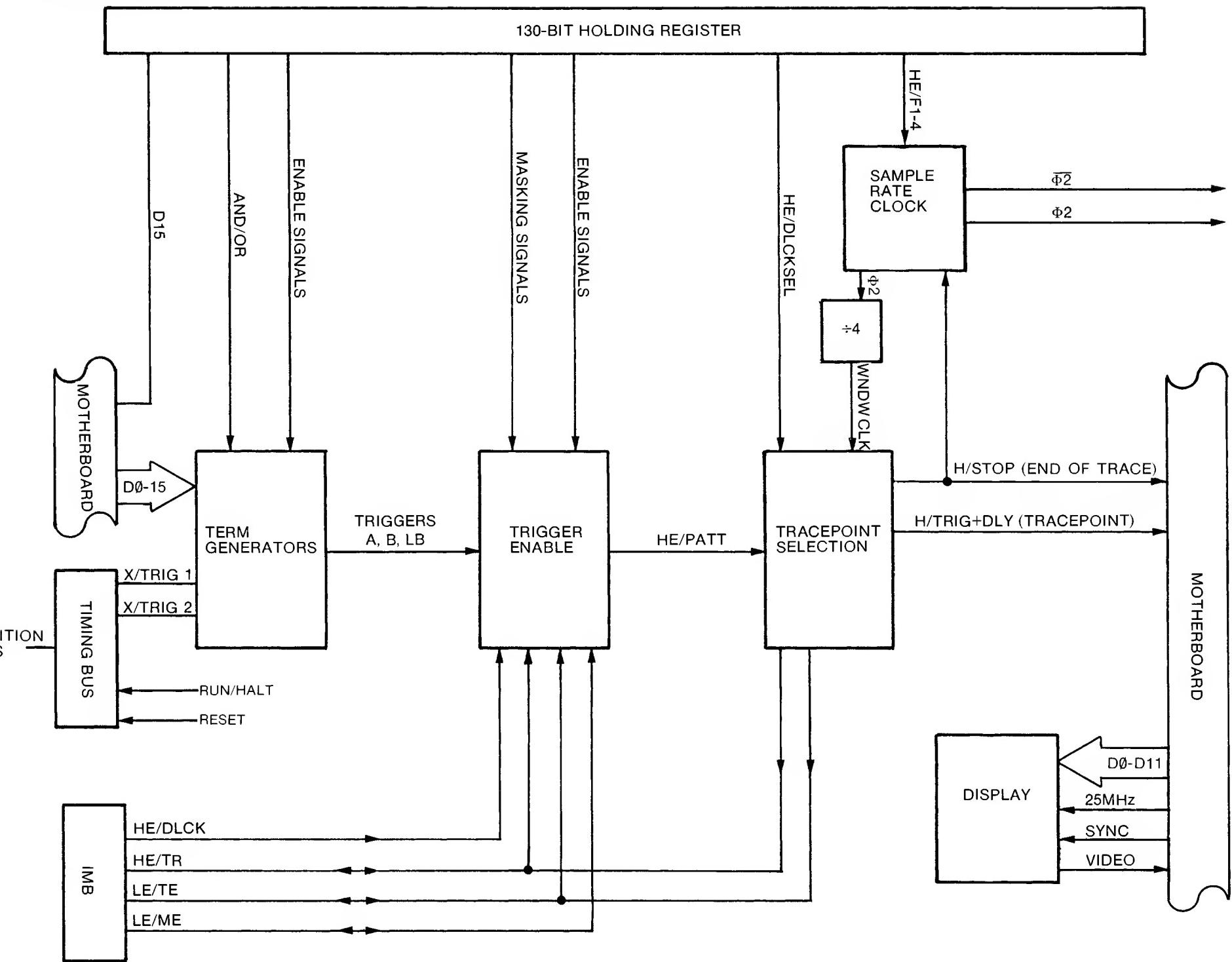
Table 8-2. Logic Symbols (Cont'd)

<b>OTHER SYMBOLS</b>					
Ⓐ Analog Signal	△ Inversion				
& AND	O Negation				
{ Bit Grouping	✗ Nonlogic Input/Output				
▷ Buffer	◊ Open Circuit (external resistor)				
! Compare	⊖ Open Circuit (external resistor)				
▷ Dynamic	≥1 OR				
=1 Exclusive OR	⊗ Passive Pull Down (internal resistor)				
TL Hysteresis	⊕ Passive Pull Up (internal resistor)				
? Interrogation	⊓ Postponed				
— Internal Connection	← Shift Left (or up)				
<b>LABELS</b>					
BG	Borrow Generate	CO	Carry Output	J	J Input
BI	Borrow Input	CP	Carry Propagate	K	K Input
BO	Borrow Output	CT	Content	P	Operand
BP	Borrow Propagate	D	Data Input	T	Transition
CG	Carry Generate	E	Extension (input or output)	+	Count Up
CI	Carry Input	F	Function	-	Count Down
<b>MATH FUNCTIONS</b>					
√	Adder	>	Greater Than		
ALU	Arithmetic Logic Unit	<	Less Than		
COMP	Comparator	CPG	Look Ahead Carry Generator		
DIV	Divide By	π	Multiplier		
=	Equal To	P-O	Subtractor		
<b>CHIP FUNCTIONS</b>					
BCD	Binary Coded Decimal	DIR	Directional	RAM	Random Access Memory
BIN	Binary	DMUX	Demultiplexer	RCVR	Line Receiver
BUF	Buffer	FF	Flip-Flop	ROM	Read Only Memory
CTR	Counter	MUX	Multiplexer	SEG	Segment
DEC	Decimal	OCT	Octal	SRG	Shift Register
<b>DELAY and MULTIVIBRATORS</b>					
□□	Astable				
100 ns	Delay				
1	Nonretriggerable Monostable				
NV	Nonvolatile				
1	Retriggerable Monostable				

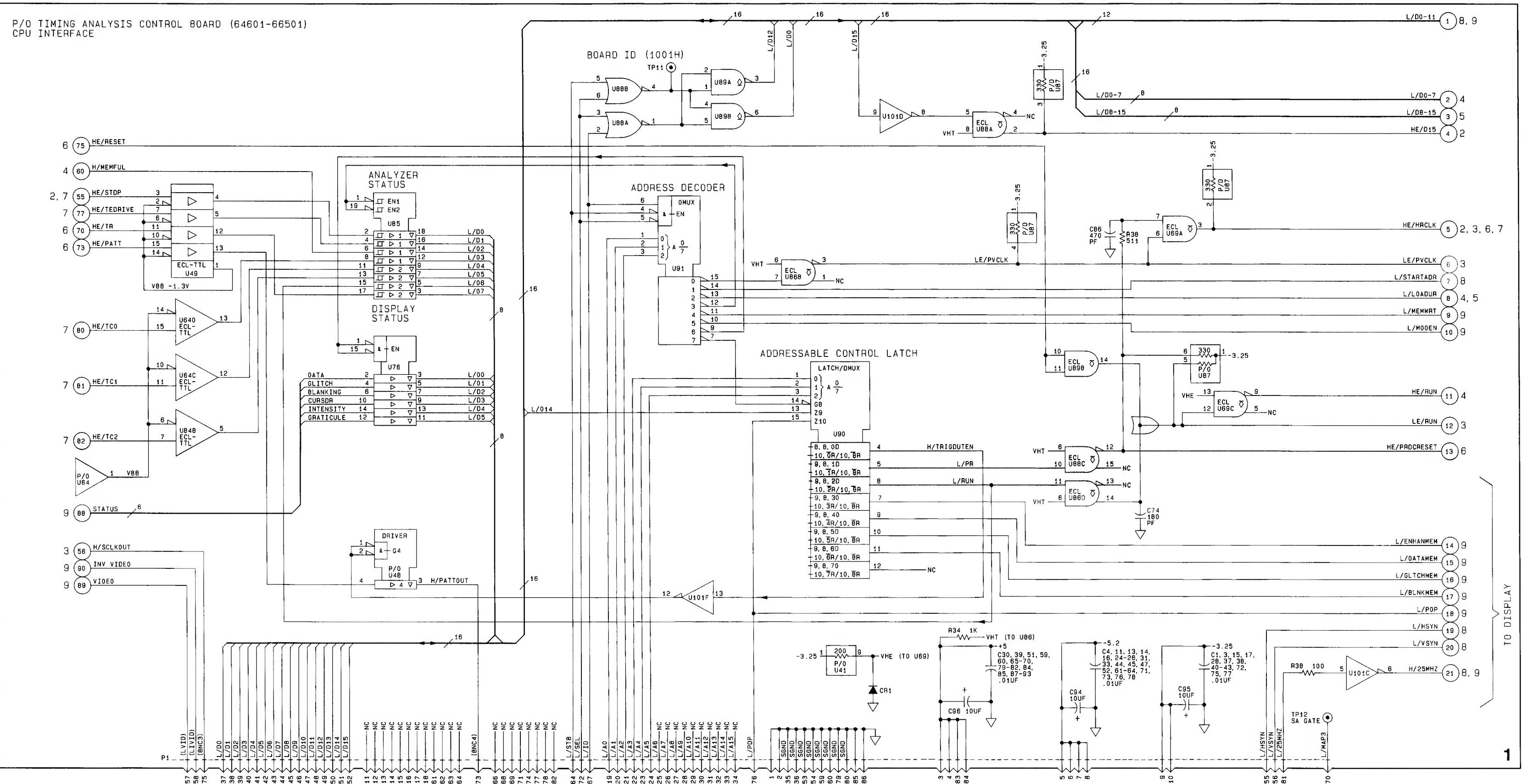
LS-08-09-82 - 3



### 64601A TIMING CONTROL BOARD



## Cs ON THIS SCHEMATIC



Ref Des	HP Part No.	Mfr. Part No.
9,64	1820-1052	MC10125L
9	1820-1400	MC10104P
6	1820-1641	SN74LS365AN
5	1820-1917	74LS240N
6	1820-1173	MC10124L
8	1820-1322	SN74S02N
9	1820-0269	SN7403N
0	1820-2799	SN74LS259
1	1820-1216	SN74LS138N
01	1820-0683	SN74S04N

## PARTS ON THIS SCHEMATIC

3, 4, 11, 13-17, 24-26, 28, 30, 31, 33,  
-45, 47, 51, 52, 59-82, 84-96

4, 36, 38

# **IC POWER SUPPLY CONFIGURATION**

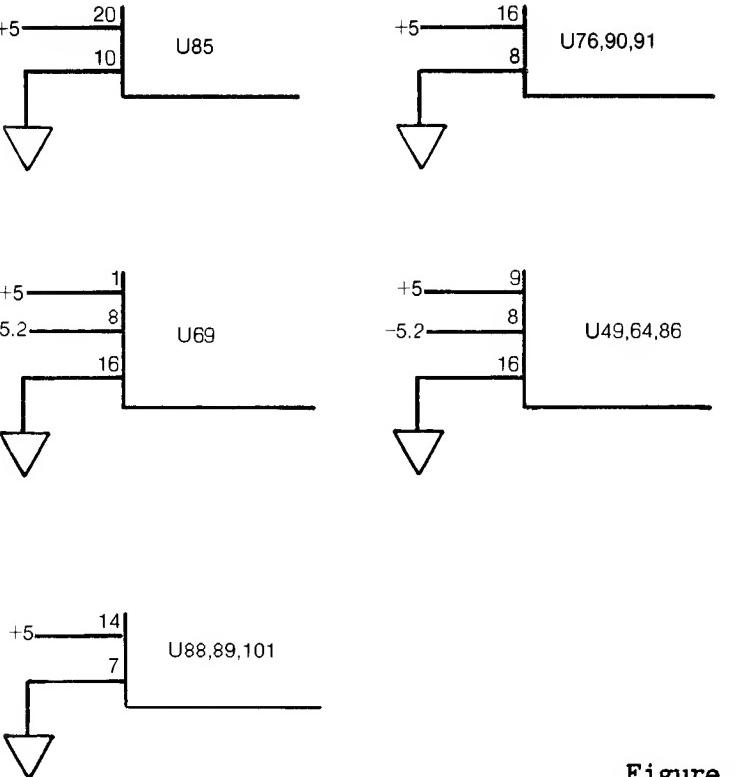
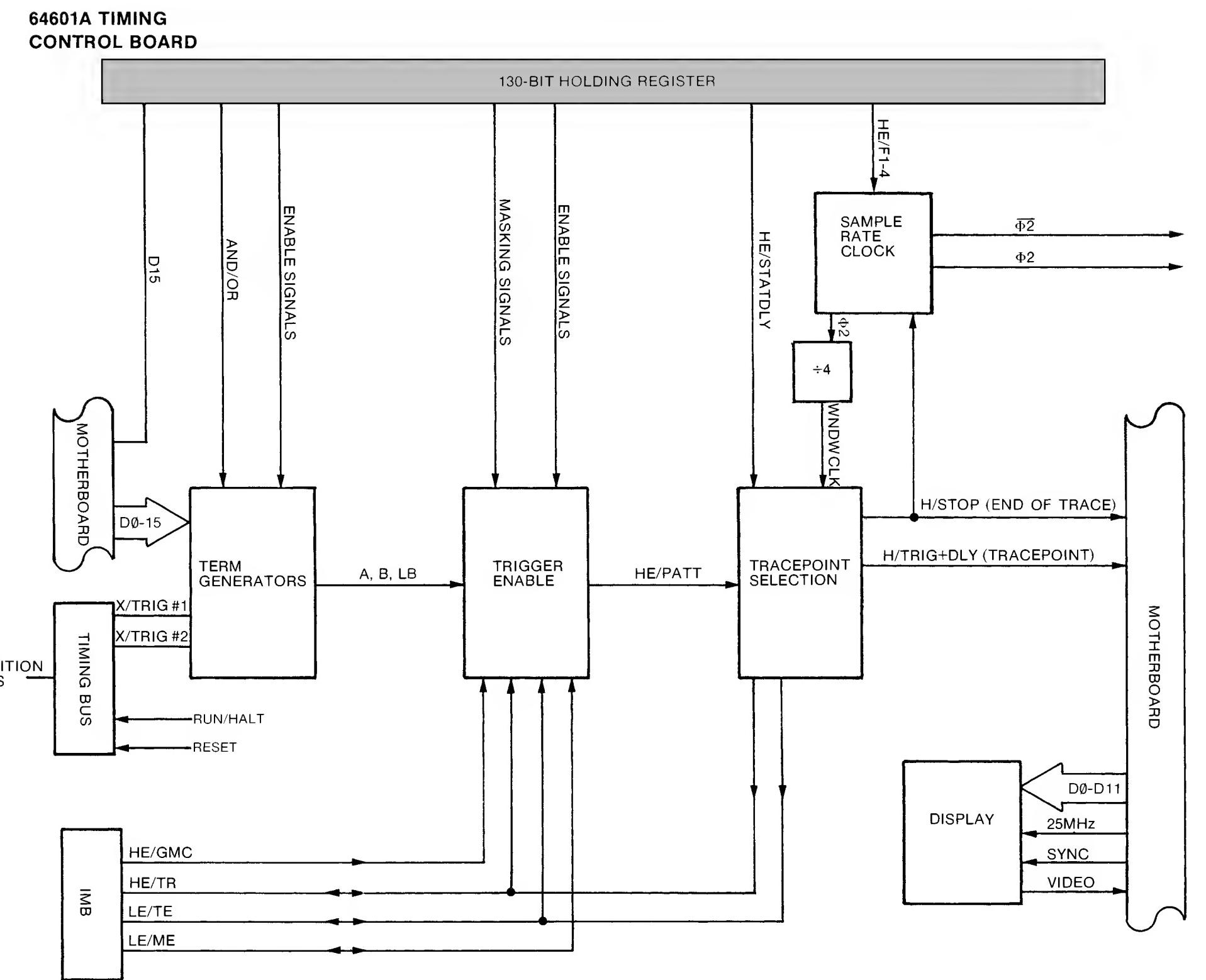
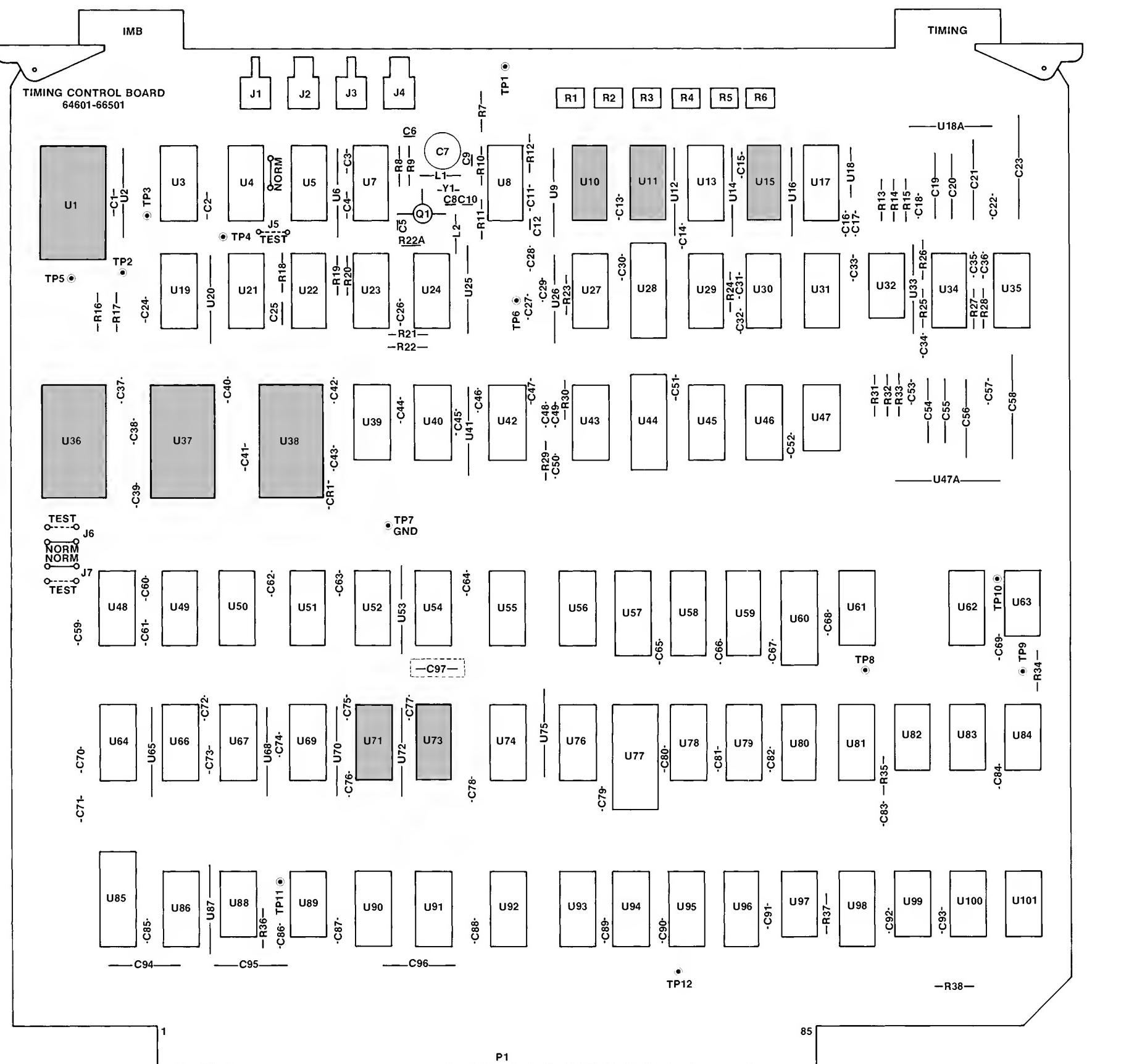
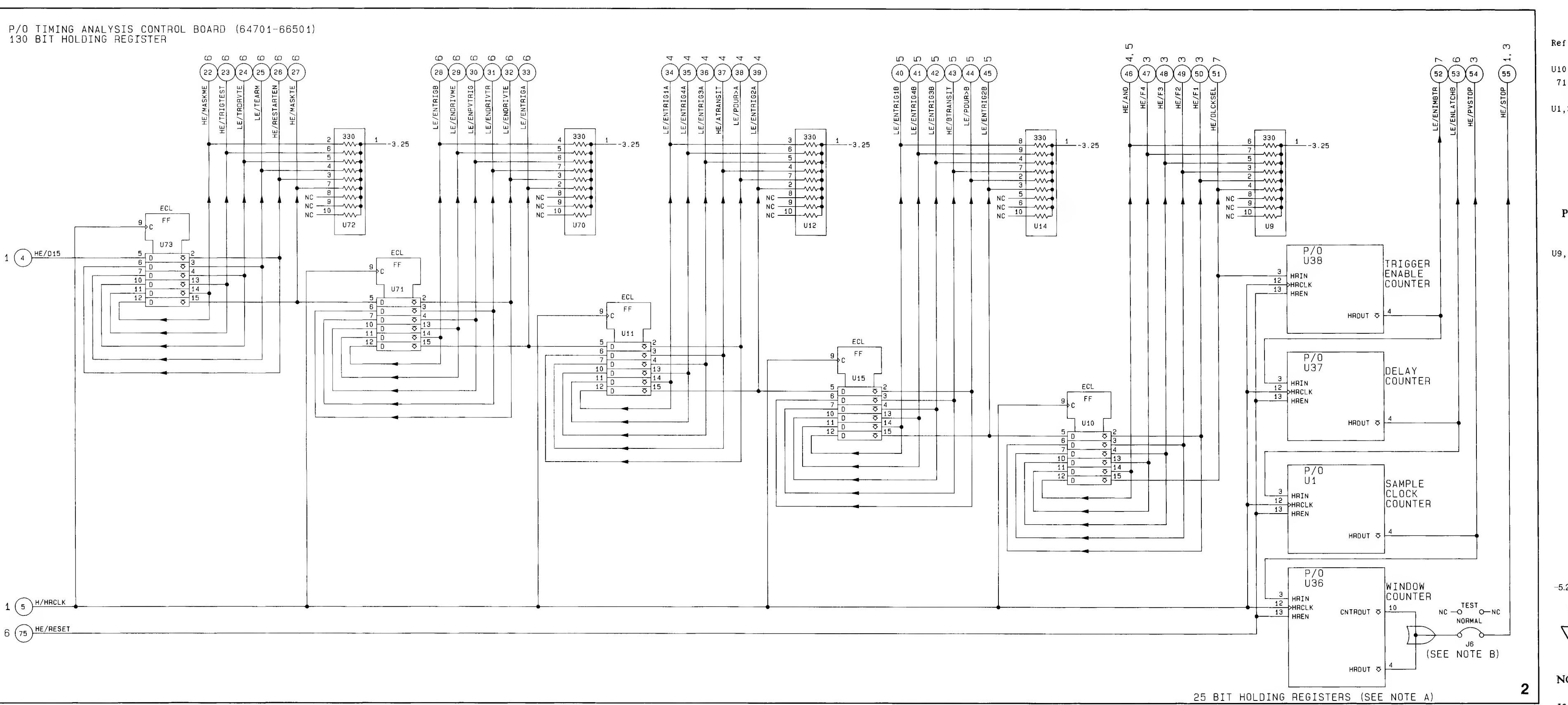


Figure 8-9.  
Service Sheet 1  
CPU Interface  
CTL 8-25





## ICs ON THIS SCHEMATIC

Ref Des	HP Part No.	Mfr. Part No.
U10,11,15 71,73	1820-2193	MC10176L
U1,36,37,38 1NB4-5008	1NB4-5008	1NB4-5008

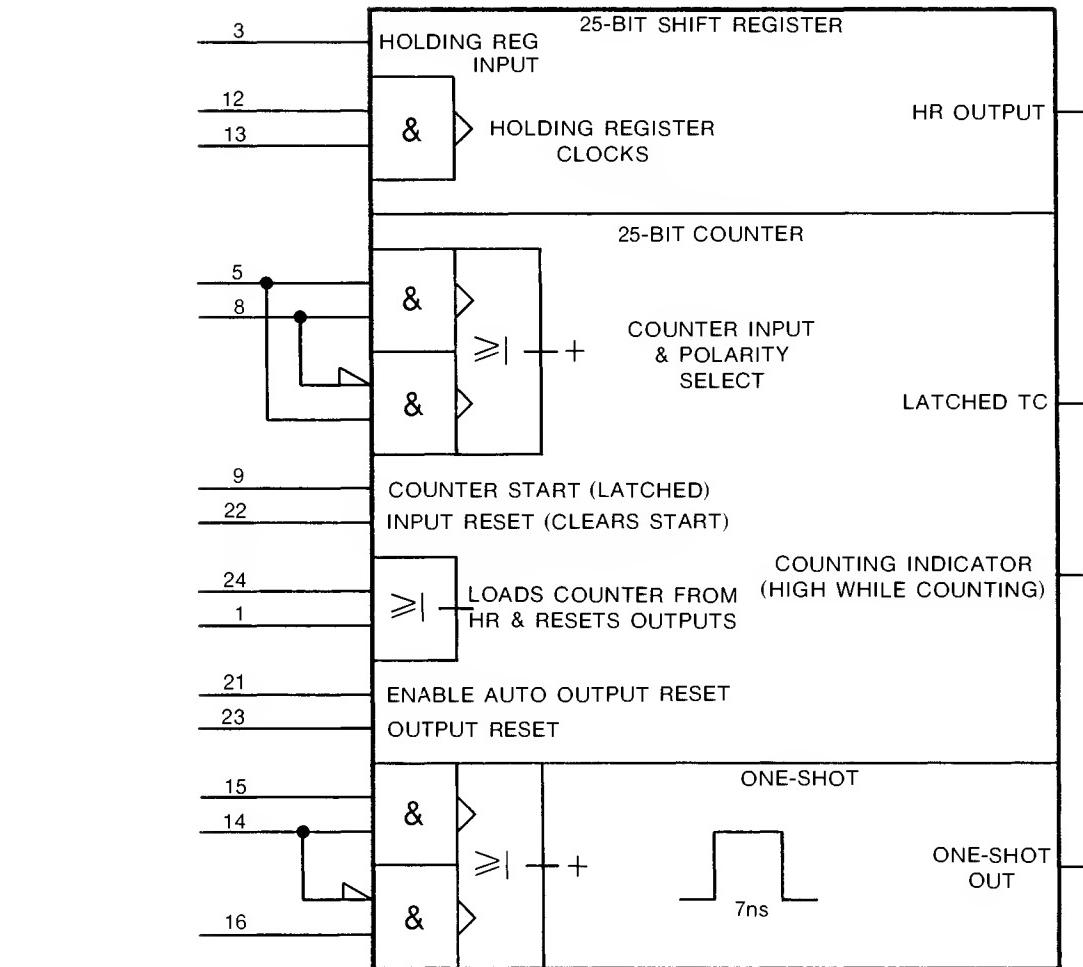
## NOTE A:

Only the holding register part of U1, 36,37,38 is shown on this schematic. For the remainder, see the following service sheets:

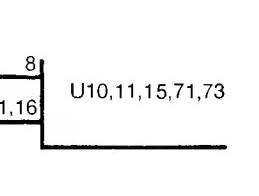
U1-----3 U38-----6  
U36-37-----7 U1, 36,37,38

## PARTS ON THIS SCHEMATIC

U9,12,14,70,72 (RESISTOR PACKS)



## IC POWER SUPPLY CONFIGURATION

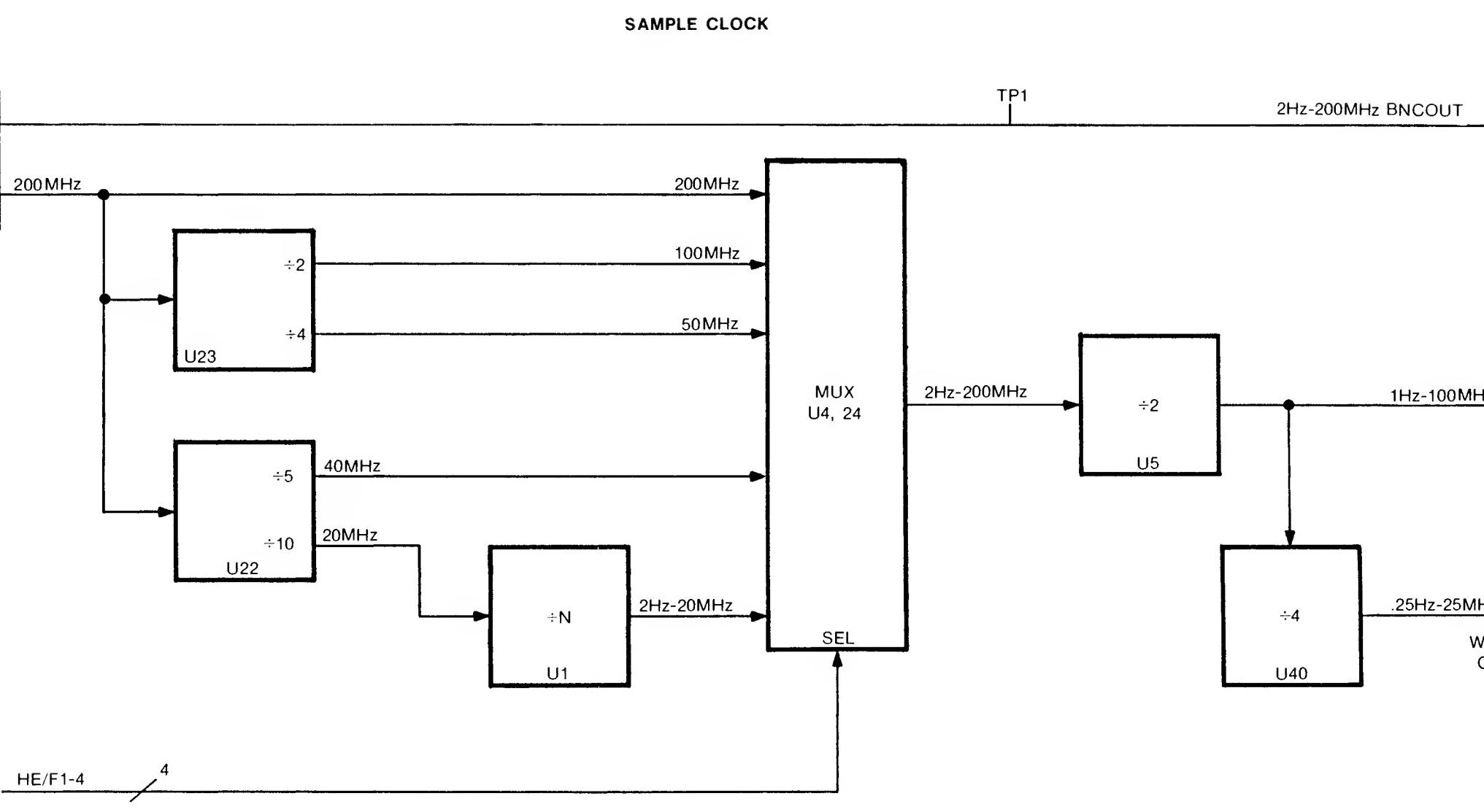
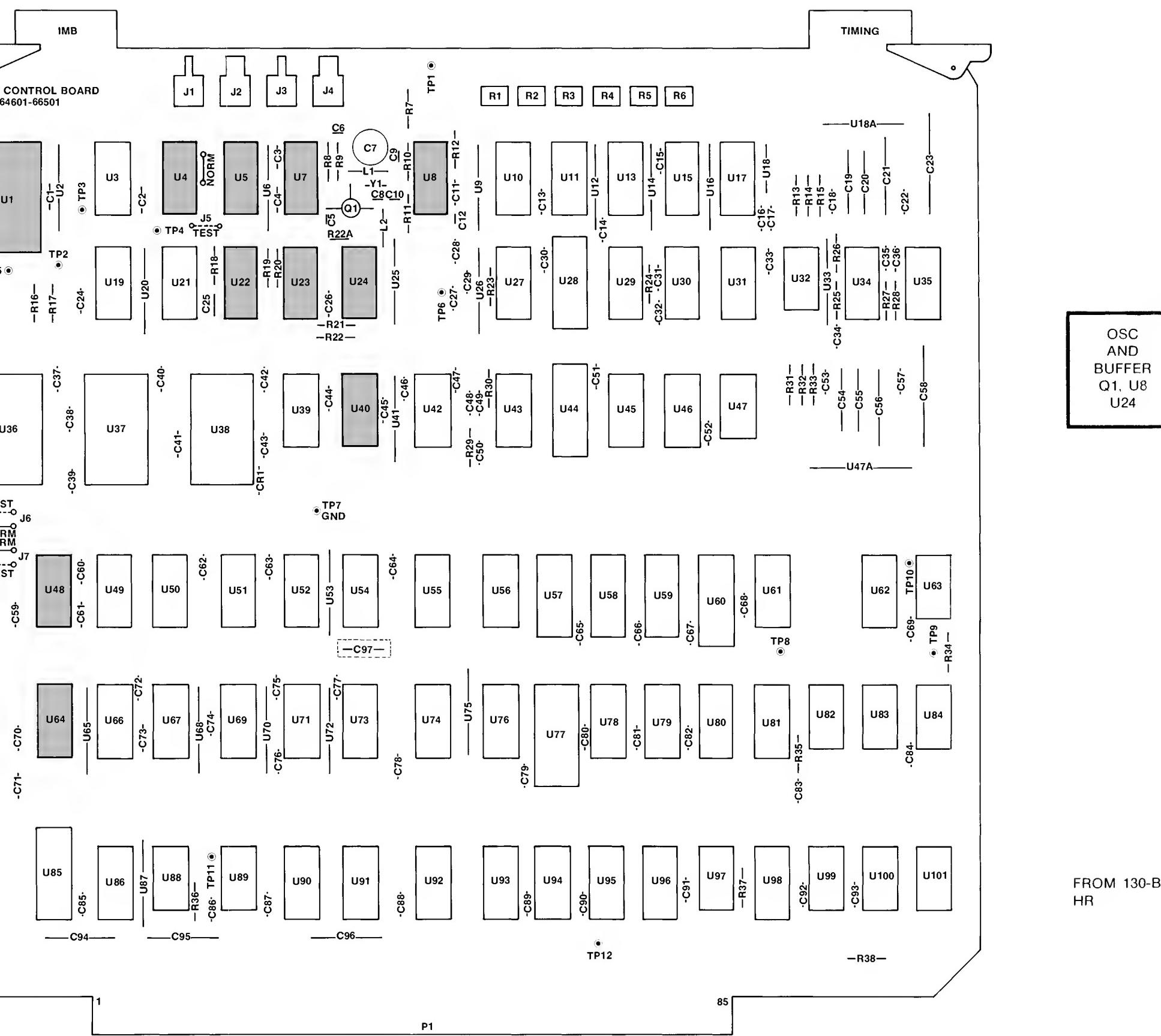


## NOTE B:

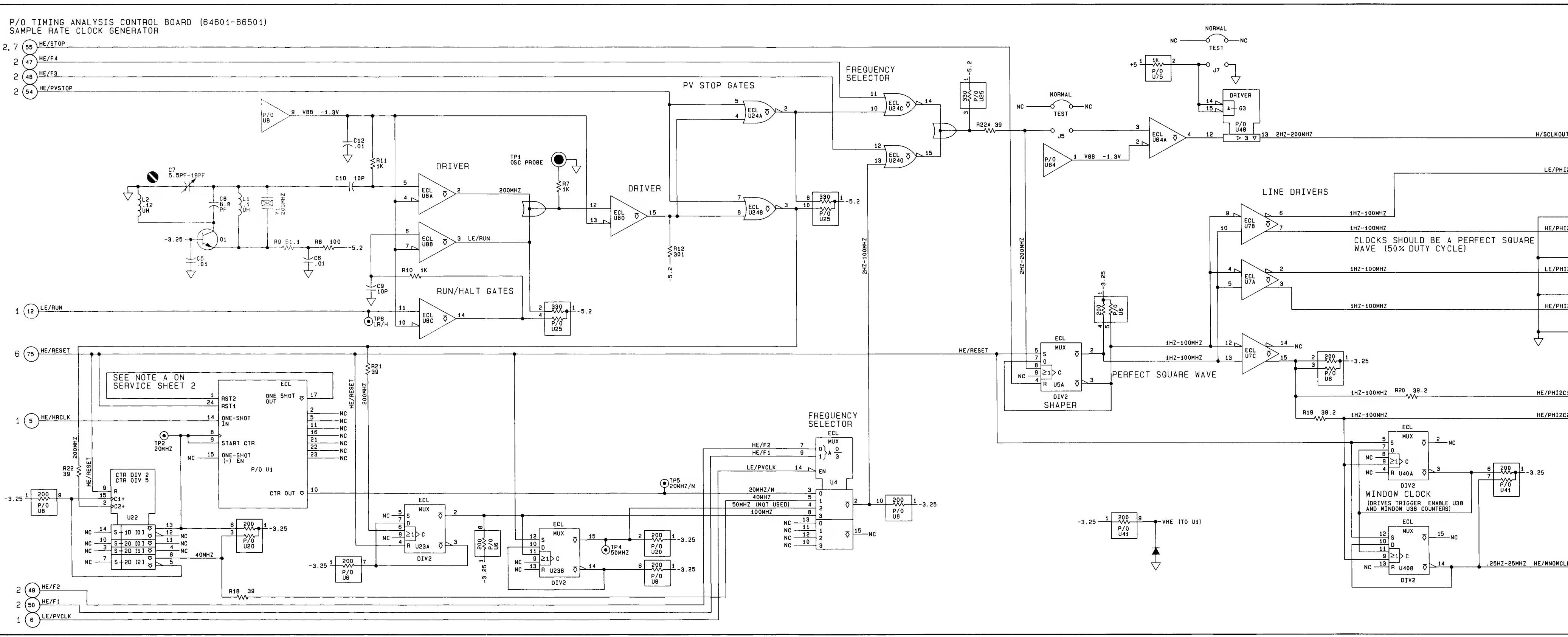
J6 is duplicated on both service sheet 2 and 7.

UNCONNECTED PINS  
U9 - PINS 8,9,10  
U12 - PINS 8,9,10  
U14 - PINS 5,6,10  
U70 - PINS 8,9,10  
U72 - PINS 8,10

Figure 8-10.  
Service Sheet 2  
130-Bit Control Shift Register  
CTL 8-27



#### ICs ON THIS SCHEMA



Ref Des	HP Part No.	Mfr. Part
U1	1NB4-5008	
U4	1820-1359	MC10174P
U5,23	1820-1225	MC10231P
U7	1820-1320	MC10216L
U8	1820-0920	MC1692L
U22	1820-2664	MC1678L
U24	1820-0796	MC1662L
U40	1820-1225	MC10231P
U48	1820-0780	DS8831N
U64	1820-1052	MC10125L

#### **PARTS ON THIS SCHEMA**

TP1,2,4-6  
J5,7  
Q1  
Y1  
L1,2  
C5-9,12  
R1,8-12,18-20,22  
U6,20,25,41,75 (RESISTOR PAC)

IC POWER SUPPLY  
CONFIGURATION

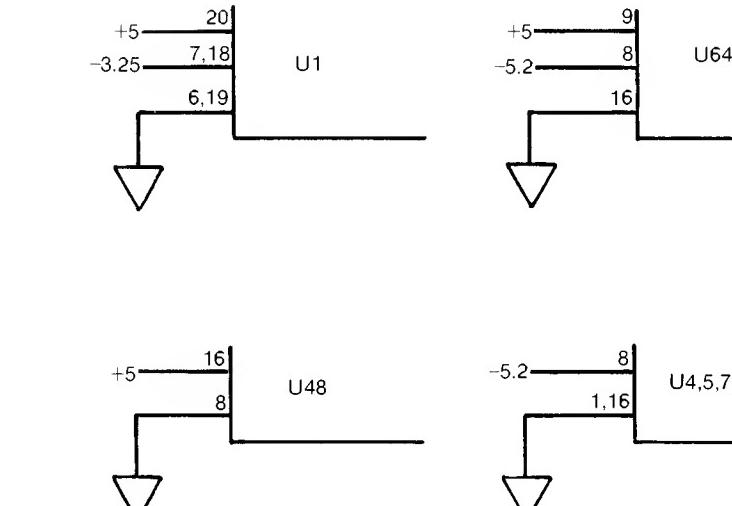
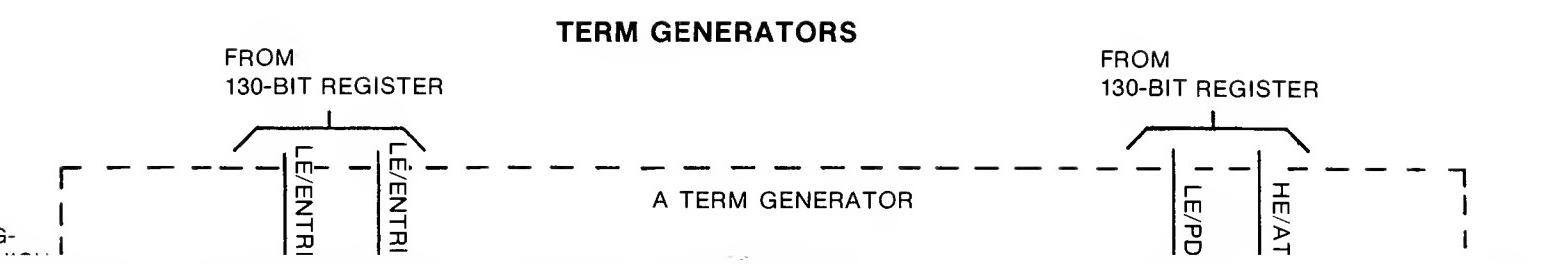


Figure 8-11  
Service Sheet  
Sample Cloc  
CTL 8-2



WAVEFORM	IC PIN	ENTERING	LEAVING	LESS THAN
1	U34-4			

WAVEFORM IC PIN ENTERING LEAVING LESS THAN

1 U34-4

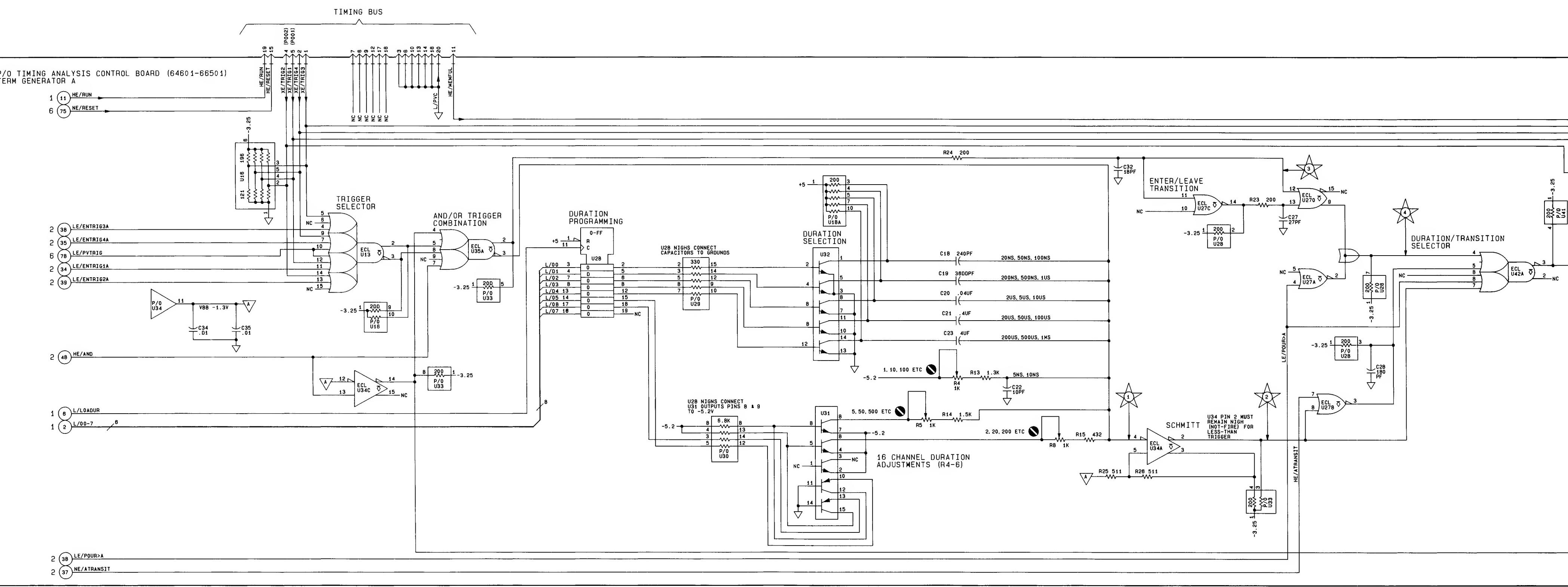
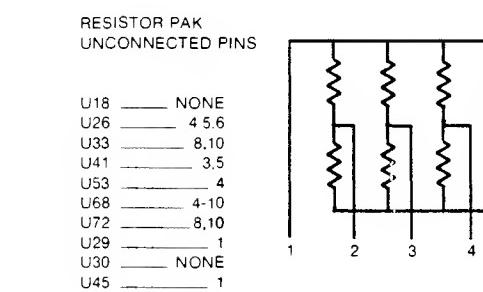
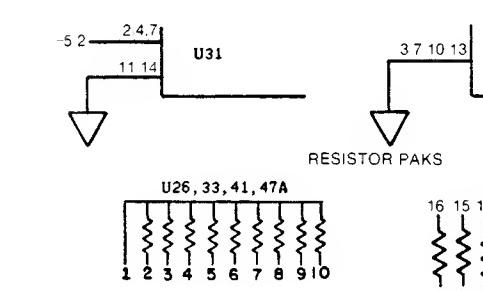
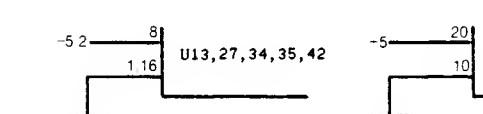
## ICs ON THIS SCHEMATICS

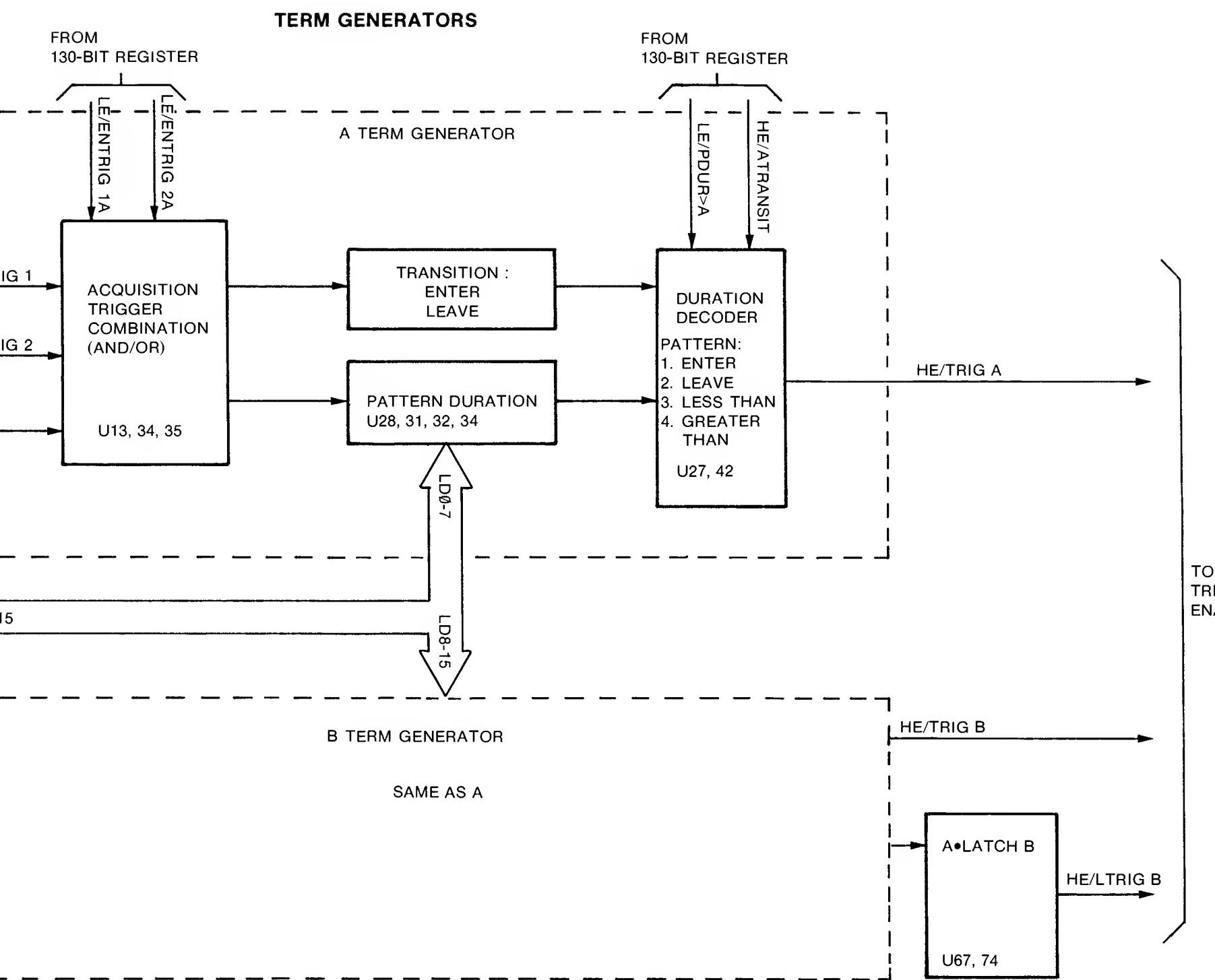
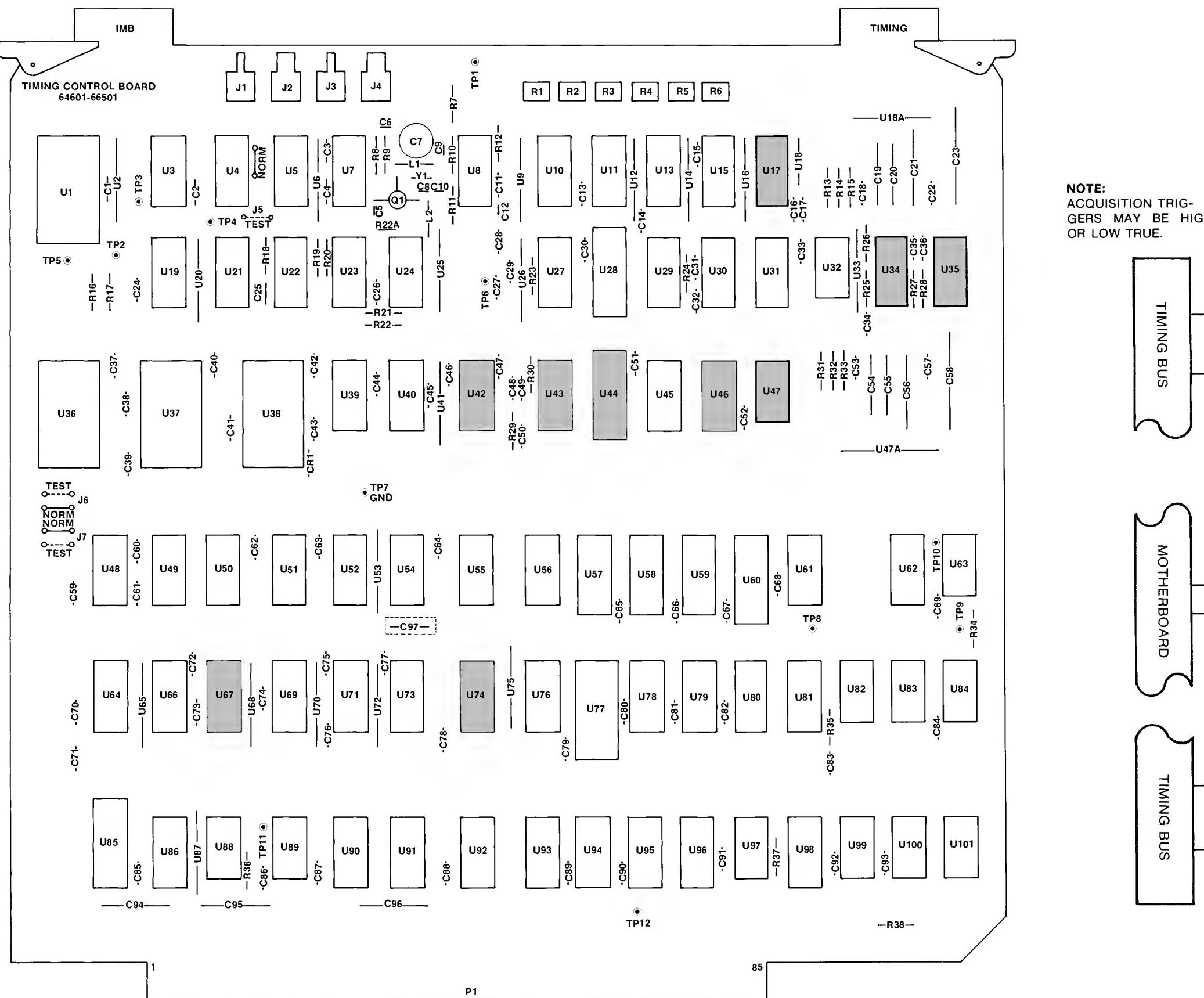
Ref Des	HF Part No.	Mfr. Part No
U13	1820-0815	MC10121P
U27	1820-0802	MC10102P
U28	1820-1730	SN74LS273N
U31	1858-0054	
U32	1821-0002	CA3054
U34	1820-1320	MC10216L
U35, 42	1820-1946	MC10117L

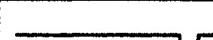
## PARTS ON THIS SCHEMATIC

C18-23, 27, 29, 32, 34, 35  
R4-6, 13-15, 23-26  
U16, 18, 18A, 26, 29, 30, 33, 41 (RESISTOR PACKS)

## IC POWER SUPPLY CONFIGURATION





WAVEFORM	IC PIN	ENTERING	LEAVING	LESS THAN
1	U34-9			
2	U34-6			
3	U43-11,12			
4	U43-9			
5	U42-14			

TRIG	HE/TRANSIT	LE/PDUR>	PATTERN MUST BE:
H	X	L	GREATER THAN SPECIFIED
H	L	H	LESS THAN SPECIFIED
H	H	H	TRANSITION LEAVING
L	H	H	TRANSITION ENTERING

## ICs ON THIS SCHEMATIC

Ref Des	HP Part No.	Mfr. Part No
U17	1820-0815	MC10121P
U34	1820-1320	MC10216P
U35, 42	1820-1946	MC10117L
U43, 67	1820-0802	MC10102P
U44	1820-1730	SN74LS273N
U46	1858-0054	
U47	1821-0002	CA3054
U74	1820-0817	MC10131P

## PARTS ON THIS SCHEMATIC

C48-50, 53-58
R1-3, 27-33
U16, 26, 30, 33, 41, 45, 47A, 68, 72 (RESISTOR PACKS)
IC POWER SUPPLY CONFIGURATION
-5.2 8 U17, 43, 67, 74 -5 20 U44
-5.2 2.4.7 U46 3.7 10 13 U47
RESISTOR PAKS U26, 33, 41, 47A U30, 45
RESISTOR PAK UNCONNECTED PINS U18

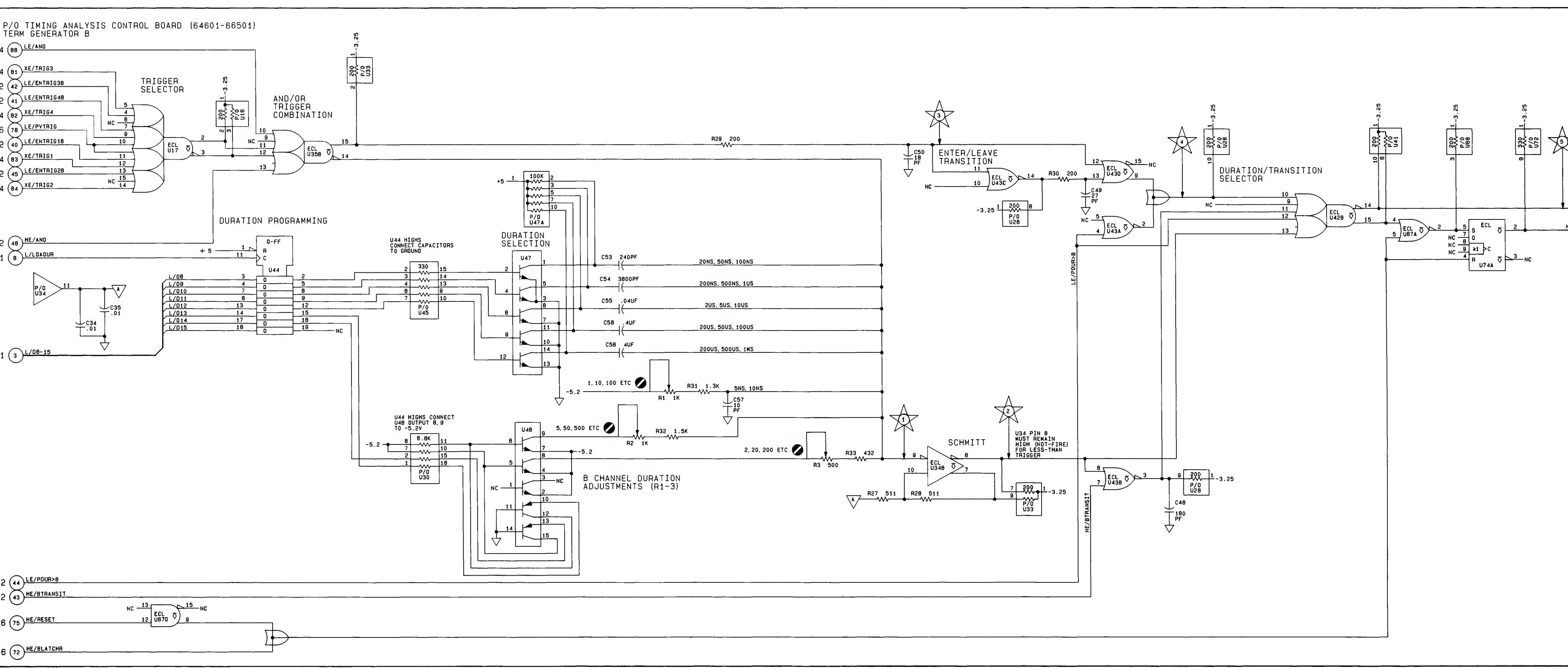
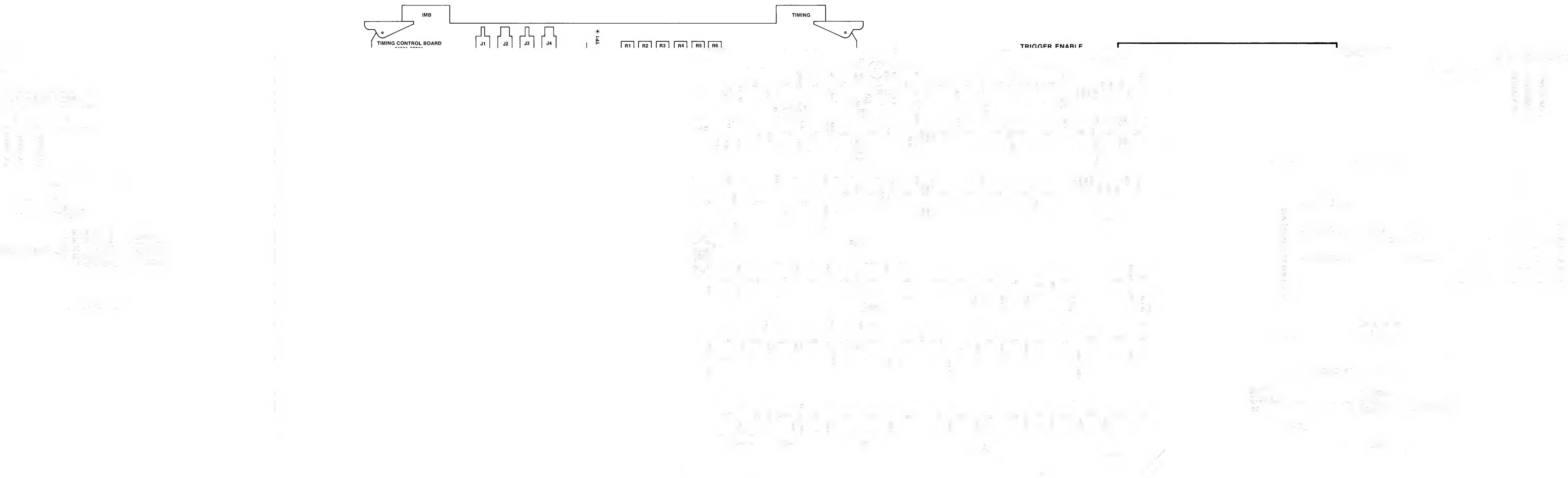
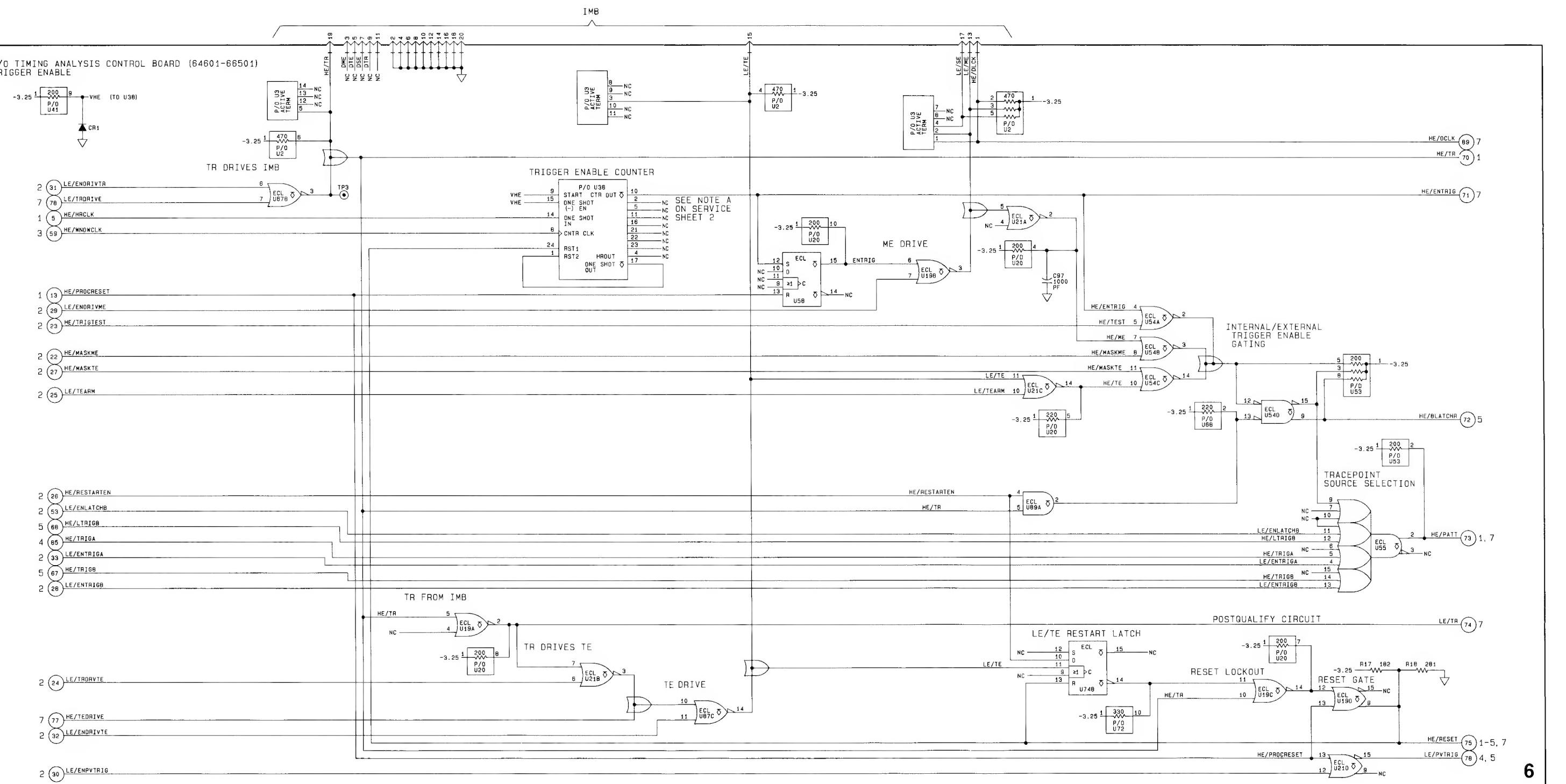
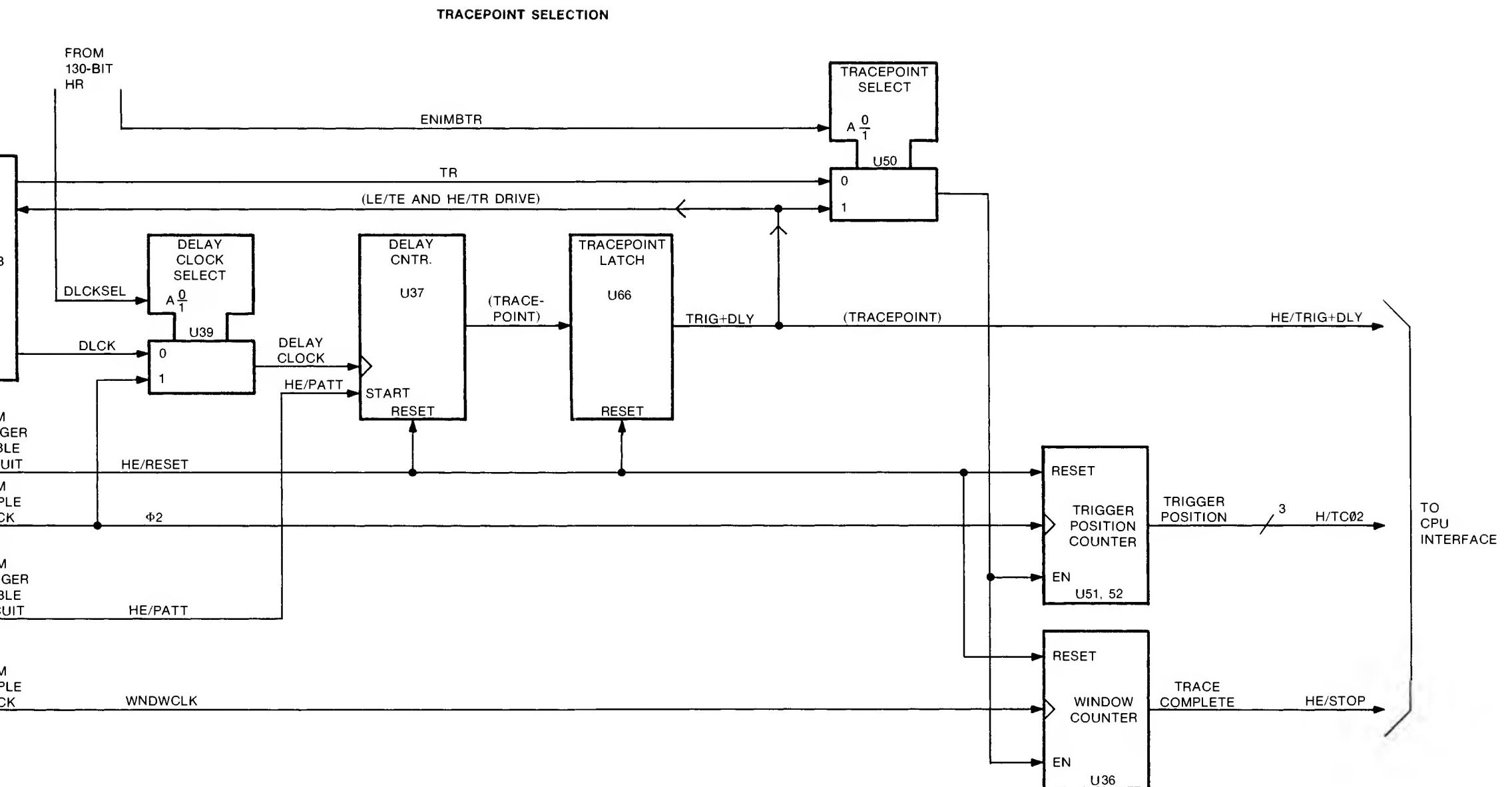
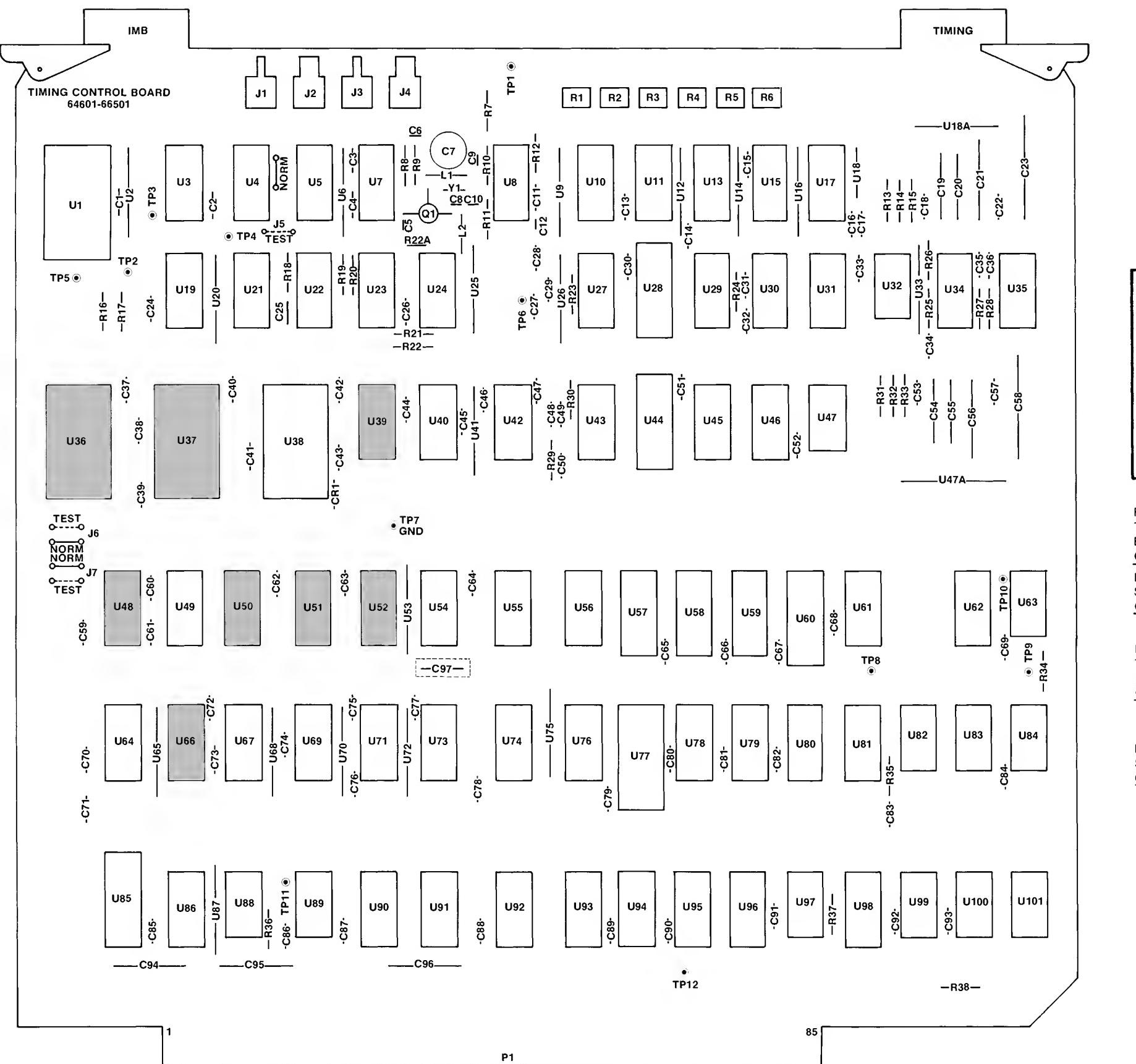


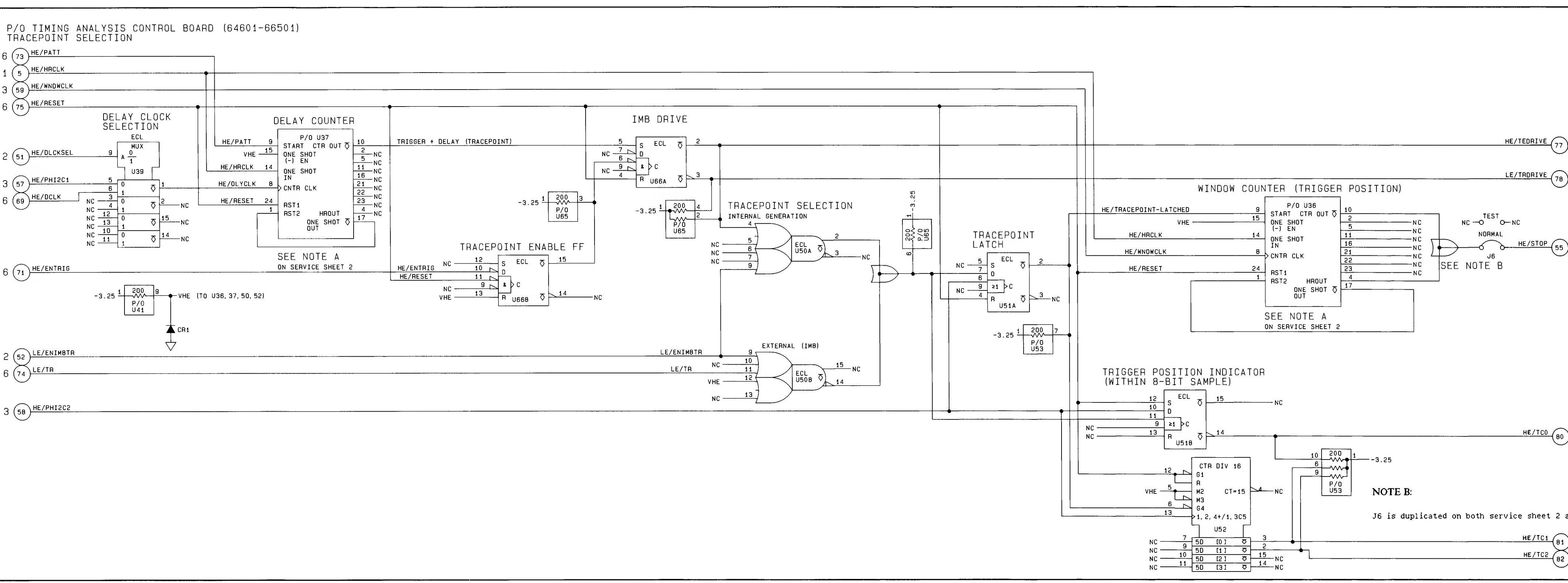
Figure 8-13.  
Service Sheet 5  
Term Generator B  
CTL 8-33



## ICs ON THIS SCHEMATIC







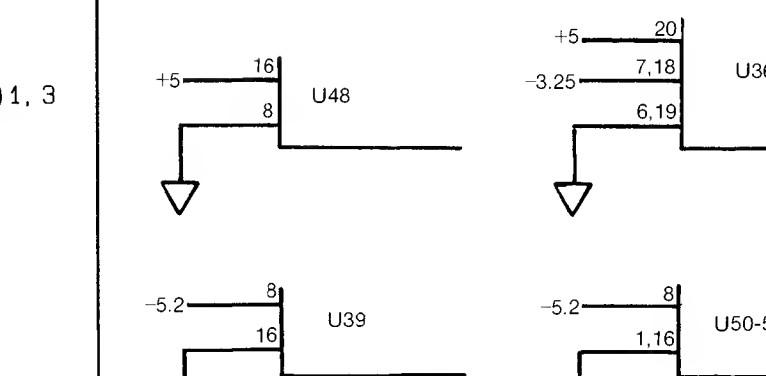
## ICs ON THIS SCHEMATIC

Ref Des	HP Part No.	Mfr. Part No.
U36,37	1NB4-5008	
U39	1820-1993	MC10158L
U48	1820-0780	DS8831N
U50	1820-1946	MC10117L
U51	1820-0817	MC10131P
U52	1820-1788	F10016DC
U66	1820-1944	MC10130L

## PARTS ON THIS SCHEMATICS

J6  
U53,65 (RESISTOR PACKS)

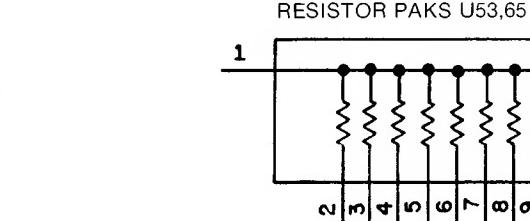
## IC POWER SUPPLY CONFIGURATION



## UNCONNECTED PINS

U53 PIN 4

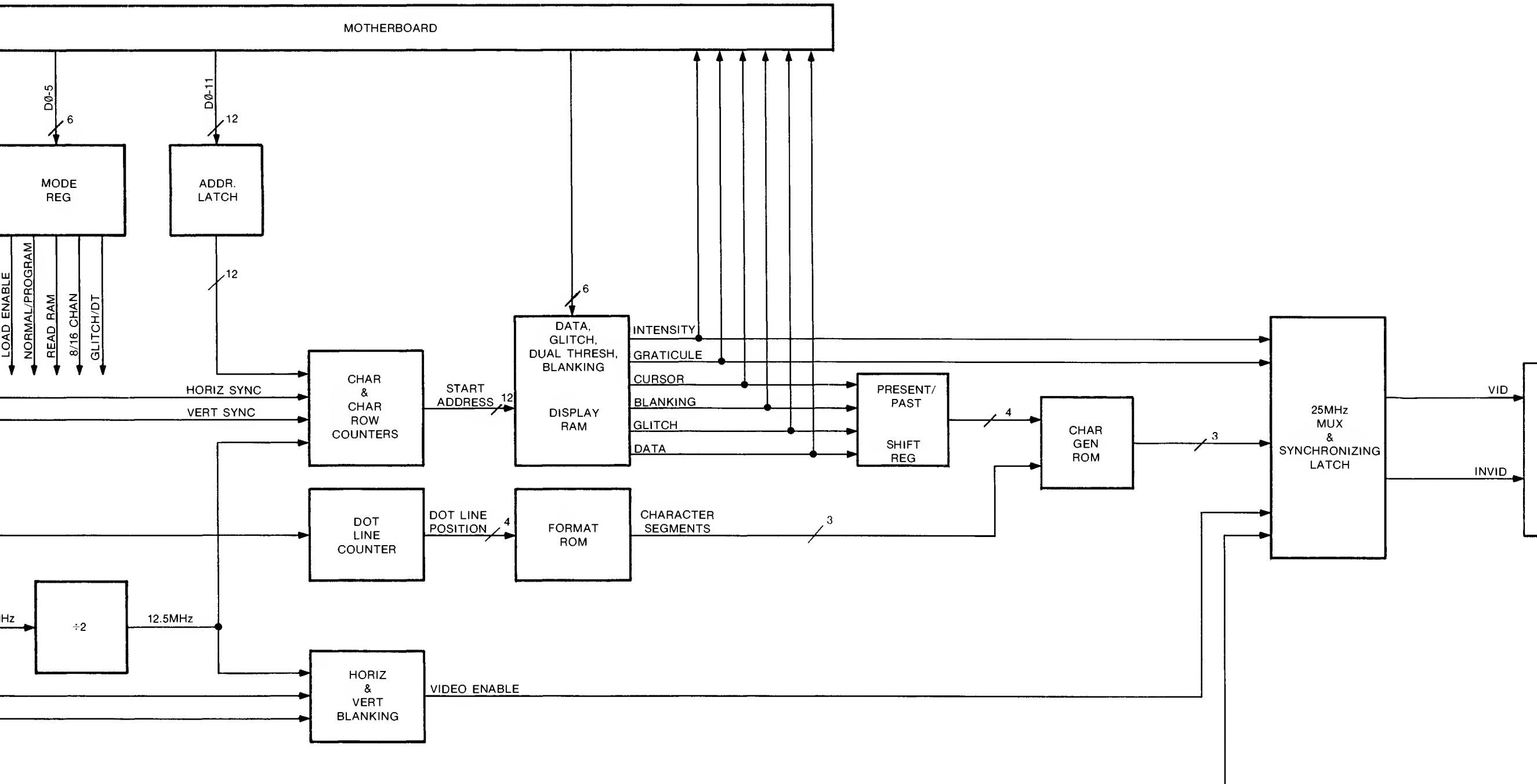
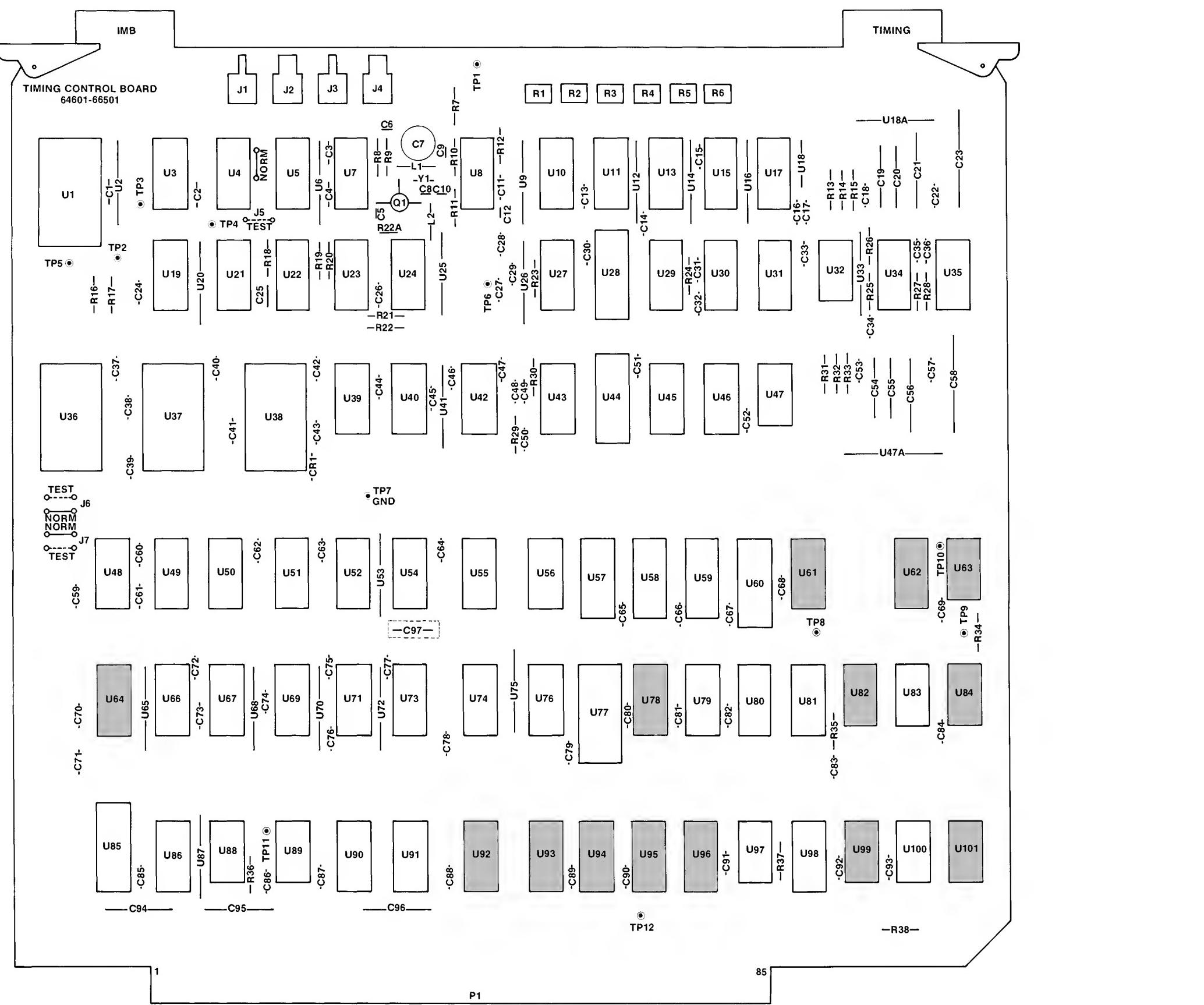
U65 5,7,10



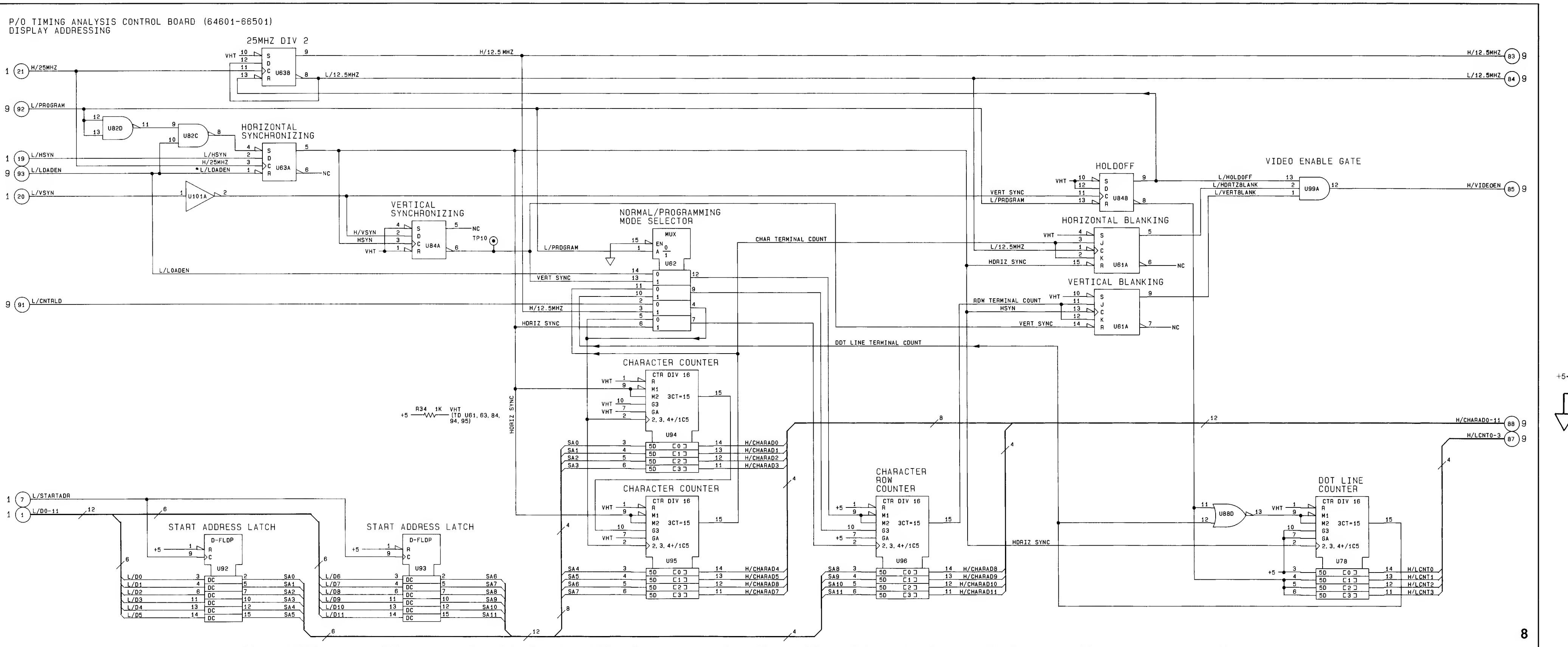
## NOTE A

THE 25 BIT HOLDING REGISTER SECTIONS  
OF U36, U37 ARE SHOWN ON SHEET 2

Figure 8-15.  
Service Sheet 7  
Tracepoint Selection  
CTL 8-37



### CS ON THIS



Des	HP Part No.
64	1820-0629
	1820-1077
84	1820-0693
96	1820-1430
	1820-1197
93	1820-1196
95	1820-1475
	1820-0686
	1820-0683

## **ARTS ON THIS S**

IC POW  
CONFIG

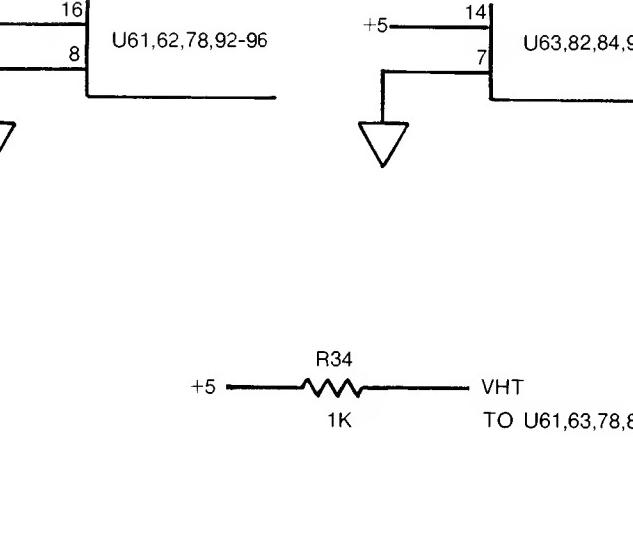
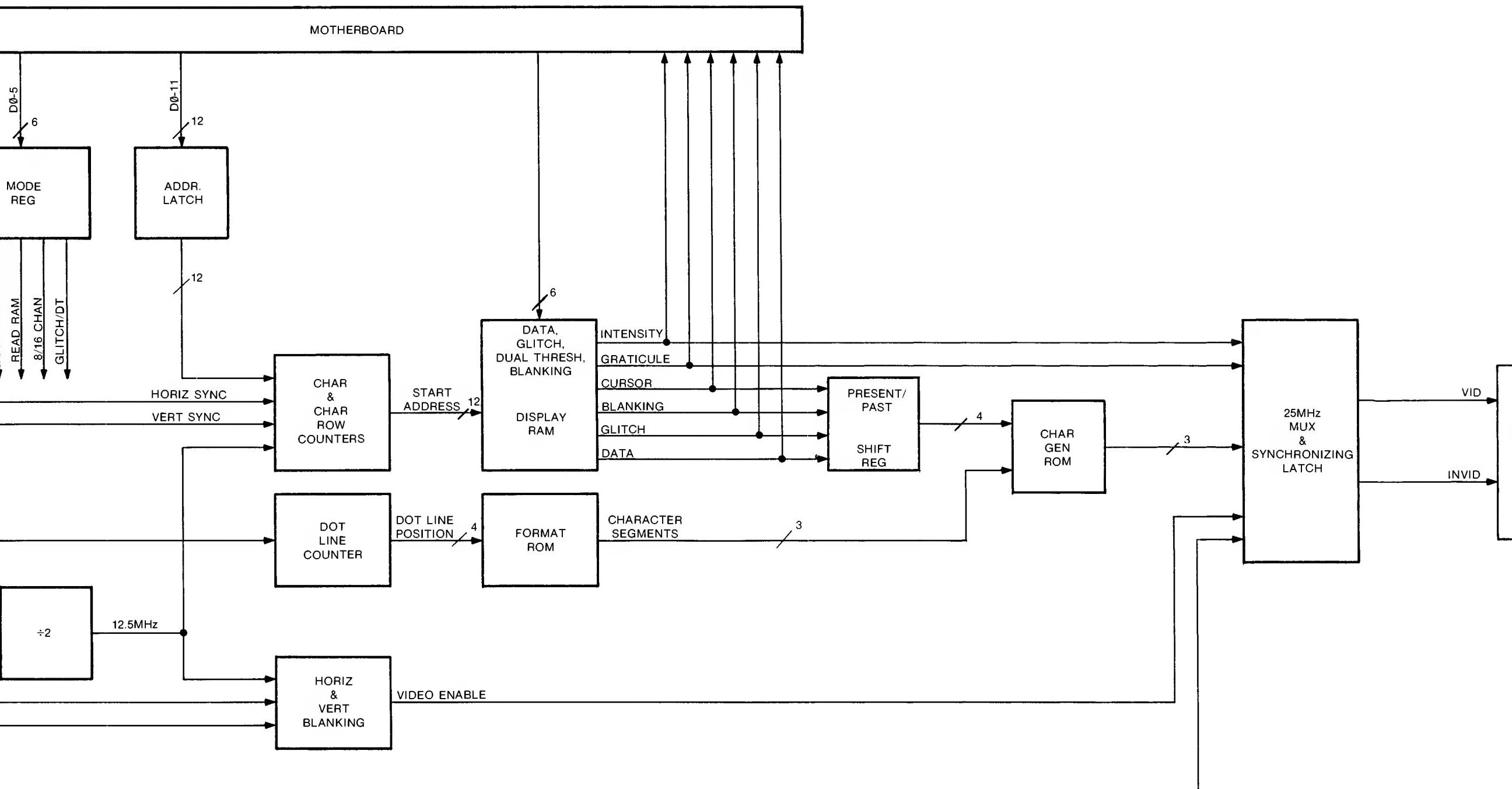
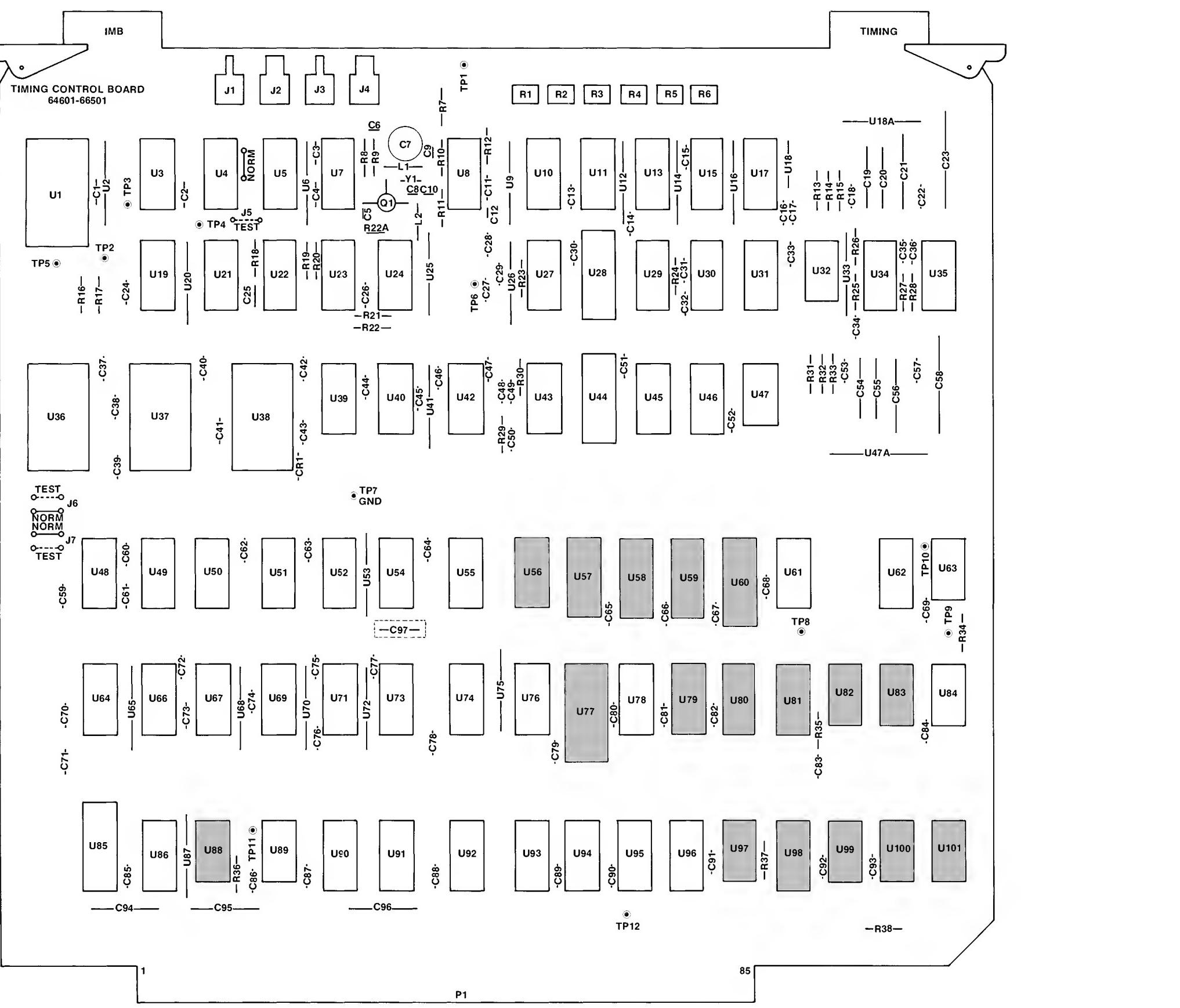


Figure 8-1  
Service Sheet  
Display Addressing  
CTL 8-



## ICs ON THIS SCHEMATIC

Ref Des	HP Part No.	Mfr. Part No.
U56	1820-1196	SN74LS174N
U57-59	1818-1596	HM6147P-3
U60	1820-1677	SN74S374N
U77	1816-1308	93L422 PC
U79	64601-10002	
U80	64601-10001	
U81	1820-1076	SN74S174N
U82	1820-1197	SN74LS00N
U83	1820-1158	SN74S51N
U88	1820-1322	SN74S02N
U97	1820-1451	SN74S38N
U98	1820-1191	SN74S175N
U99	1820-0686	SN74S11N
U100	1820-0693	SN74S74N
U101	1820-0683	SN74S04N

## PARTS ON THIS SCHEMATIC

C83

R35, 37

U75 (RESISTOR PACK)

## IC POWER SUPPLY CONFIGURATION

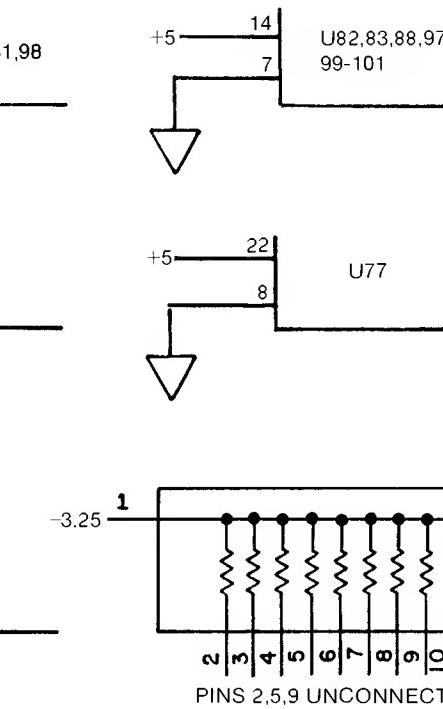
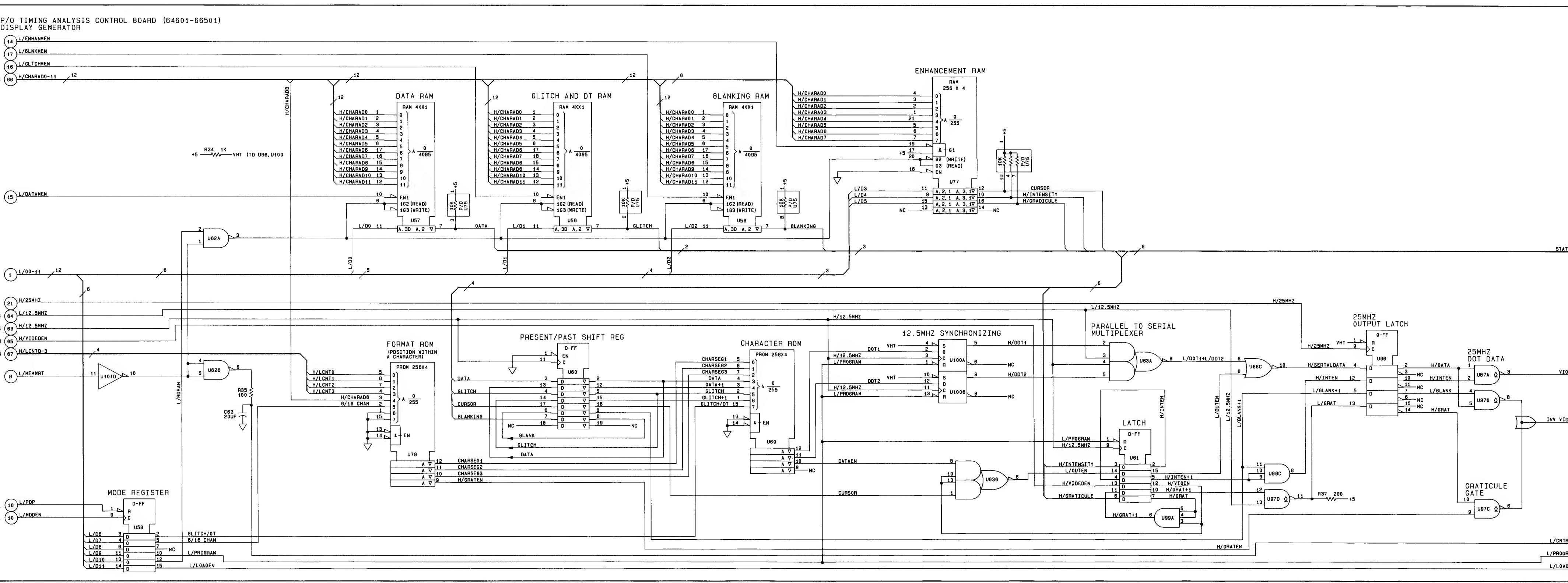


Figure 8-17.  
Service Sheet 9  
Display Driver  
CTL 8-41





# SALES & SUPPORT OFFICES

Arranged alphabetically by country



## Product Line Sales/Support Key

**K**ay Product Line  
**A**nalytical  
**CM** Components  
**C** Computer Systems Sales only  
**CH** Computer Systems Hardware Sales and Services  
**CS** Computer Systems Software Sales and Services  
**E** Electronic Instruments & Measurement Systems  
**M** Medical Products  
**MP** Medical Products Primary SRO  
**MS** Medical Products Secondary SRO  
**P** Personal Computation Products  
 \* Sales only for specific product line  
 \*\* Support only for specific product line

**IMPORTANT:** These symbols designate general product line capability. They do not insure sales or support availability for all products within a line, at all locations. Contact your local sales office for information regarding locations where HP support is available for specific products.

*HP distributors are printed in italics.*

## ANGOLA

*Telectra*  
*Empresa Técnica de Equipamentos*  
*R. Barbosa Rodrigues, 41-IDT.*  
*Caixa Postal 6487*  
*LUANDA*  
*Tel: 355 15, 355 16*  
*E,M,P*

## Melbourne, Victoria Office

*Hewlett-Packard Australia Ltd.*  
 31-41 Joseph Street  
*BLACKBURN, Victoria 3130*  
 Tel: 890 6351  
 Telex: 31-024  
 Cable: HEWPARO Melbourne  
*A,CH,CM,CS,E,MS,P*

## BELGIUM

*Hewlett-Packard Belgium S.A./N.V.*  
 81vd de la Woluwe, 100  
*Woluwe*  
 8-1200 BRUSSELS  
 Tel: (02) 762-32-00  
 Telex: 23-494 palaben bru  
*A,CH,CM,CS,E,MP,P*

## BRAZIL

*Hewlett-Packard do Brasil I.e.C.*  
*Ltda.*  
*Alameda Rio Negro, 750*  
*Alphaville*  
 06400 BARUERI SP  
 Tel: (011) 421.1311  
 Telex: (011) 33872 HPBR-BR  
 Cable: HEWPACK Sao Paulo  
*A,CH,CM,CS,E,MP,P*  
*Hewlett-Packard do Brasil I.e.C.*  
*Ltda.*  
 Avenida Epitacio Pessoa, 4664  
 22471 RIO DE JANEIRO-RJ  
 Tel: (021) 286.0237  
 Telex: 021-21905 HPBR-BR  
 Cable: HEWPACK Rio de Janeiro  
*A,CH,CM,E,MS,P\**

## CANADA

*Alberta*  
*Hewlett-Packard (Canada) Ltd.*

*Hewlett-Packard (Canada) Ltd.*  
 2670 Queensview Dr.  
*OTTAWA, Ontario K2B 8K1*

*Woluwe*  
 Tel: (613) 820-6483  
*A,CH,CM,CS,E,MS,P\**  
*Hewlett-Packard (Canada) Ltd.*  
 220 Yorkland 8Ivd., Unit #11  
*WILLOWSDALE, Ontario M2J 1R5*  
 Tel: (416) 499-9333

CH

## QUEBEC

*Hewlett-Packard (Canada) Ltd.*  
 17500 South Service Road  
*Trans-Canada Highway*  
*KIRKLAND, Quebec H9J 2M5*  
 Tel: (514) 697-4232  
*A,CH,CM,CS,E,MS,P\**  
*Hewlett-Packard (Canada) Ltd.*  
*Les Galeries du Vallon*  
 2323 Ou Verson Nord  
*STE. FOY, Quebec G1N 4C2*  
 Tel: (418) 687-4570

CH

## CHILE

*Jorge Calcagni y Cia. Ltda.*  
*Arturo Buhle 065*  
*Casilla 16475*  
*SANTIAGO 9*  
 Tel: 222-0222

## CYPRUS

*Telerexa Ltd.*  
*P.O. Box 4809*  
*14C Stassinos Avenue*  
*NICOSIA*  
 Tel: 62698  
*Telex: 2894 LEVIDO CY*  
*E,MP*

## DENMARK

*Hewlett-Packard A/S*  
*Oatavej 52*  
*OK-3460 BIRKEROD*  
 Tel: (02) 81-66-40  
*Telex: 37409 hpas dk*  
*A,CH,CM,CS,E,MS,P*  
*Hewlett-Packard A/S*  
*Rolighedsvej 32*  
*OK-8240 RISSKOV*  
 Tel: (06) 17-60-00  
*Telex: 37409 hpas dk*  
*CH,E*

## DOMINICAN REPUBLIC

*Microprog S.A.*  
*Juan Tomás Mejía y Cotes No. 60*  
*Arroyo Hondo*  
*SANTO DOMINGO*  
 Tel: 565-6268  
*Telex: 4510 ARENTA DR (RCA)*  
*P*



# SALES & SUPPORT OFFICES

Arranged alphabetically by country

## FINLAND

Hewlett-Packard Oy  
Revontuletie 7  
SF-02100 ESPOO 10  
Tel: 00358-0-4550211  
Telex: 9100  
A.CH,CM,CS,E,MS,P  
Hewlett-Packard Oy  
Aatoksenkatu 10-C  
SF-40720-72 JYVASKYLA  
Tel: (941) 216318  
CH

Hewlett-Packard Oy  
Kainuuntie 1-C  
SF-90140-14 OULU  
Tel: (981) 338785  
CH

## FRANCE

Hewlett-Packard France  
Z.I. Mercure B  
Rue Berthelot  
F-13763 Les Milles Cedex  
AIX-EN-PROVENCE  
Tel: 16 (42) 59-41-02  
Telex: 410770F  
A,CH,CS,P\*  
Hewlett-Packard France  
64, rue Marchand Saillani  
F-61000 ALENCON  
Tel: 16 (33) 29 04 42  
Hewlett-Packard France  
Boite Postale 503  
F-25026 BESANCON  
28 rue de la Republique  
F-25000 BESANCON  
Tel: 16 (81) 83-16-22  
CH,M  
Hewlett-Packard France  
13, Place Napoleon III  
F-29000 BREST  
Tel: 16 (98) 03-38-35  
Hewlett-Packard France  
Chemin des Mouilles  
Boite Postale 162  
F-69130 ECULLY Cedex  
Tel: 16 (78) 833-81-25  
Telex: 310617F  
A,CH,CS,E,MP  
Hewlett-Packard France  
Tour Lorraine  
Boulevard de France  
F-91035 EVRY Cedex  
Tel: 16 6 077-96-60  
Telex: 692315F  
E

Hewlett-Packard France  
5, avenue Raymond Chanas  
F-38320 EYBENS  
Tel: 16 (76) 25-81-41  
Telex: 980124 HP GRENOB EYBE  
CH

Hewlett-Packard France  
Centre d'Affaire Paris-Nord  
Batiment Ampere 5 etage  
Rue de la Commune de Paris  
Boite Postale 300  
F-93153 LE BLANC MESNIL  
Tel: 16 (1) 865-44-52  
Telex: 211032F  
CH,CS,E,MS  
Hewlett-Packard France  
Parc d'Activites Cadera  
Quartier Jean Mermoz  
Avenue du President JF Kennedy  
F-33700 MERIGNAC  
Tel: 16 (56) 34-00-84  
Telex: 550105F  
CH,E,MS

## GERMAN FEDERAL REPUBLIC

Hewlett-Packard France  
Immuble "Les 3 B"  
Nouveau Chemin de la Garde  
ZAC de Bois Briand  
F-44085 NANTES Cedex  
Tel: 16 (40) 50-32-22  
CH\*\*

Hewlett-Packard France  
125, rue du Faubourg Bannier  
F-45000 ORLEANS  
Tel: 16 (38) 68 01 63

Hewlett-Packard France  
Zone Industrielle de Courtalouet  
Avenue des Tropiques  
F-91947 Les Ulis Cedex ORSAY  
Tel: (6) 907-78-25  
Telex: 600048F  
A,CH,CM,CS,E,MP,P

Hewlett-Packard France  
15, Avenue de L'Amiral Bruix  
F-75782 PARIS CEDEX 16  
Tel: 16 (1) 502-12-20  
Telex: 613663F  
CH,MS,P

Hewlett-Packard France  
124, Boulevard Tourrasse  
F-64000 PAU  
Tel: 16 (59) 80 38 02

Hewlett-Packard France  
2 Allée de la Bourgogne  
F-35100 RENNES  
Tel: 16 (99) 51-42-44  
Telex: 740912F  
CH,CM,E,MS,P\*

Hewlett-Packard France  
98 Avenue de Bretagne  
F-76100 ROUEN  
Tel: 16 (35) 63-57-66  
CH\*\*,CS

Hewlett-Packard France  
Boite Postale 56  
F-67033 STRASBOURG Cedex  
4 Rue Thomas Mann  
F-67200 STRASBOURG Cedex  
Tel: 16 (88) 28-56-46  
Telex: 890141F  
CH,E,MS,P\*

Hewlett-Packard France  
Le Péripole  
3, Chemin du Pigeonnier de la  
Cépière  
F-31083 TOULOUSE Cedex  
Tel: 16 (61) 40-11-12  
Telex: 531639F  
A,CH,CS,E,P\*

Hewlett-Packard France  
9, rue Baudin  
F-26000 VALENCE  
Tel: 16 (75) 42 76 16

Hewlett-Packard France  
Garolor  
ZAC de Bois Briand  
F-57640 VIGY  
Tel: 16 (8) 77 20 22  
CH

Hewlett-Packard France  
Immeuble Péricentre  
F-59658 VILLENEUVE D'ASCQ Cedex  
Tel: 16 (20) 91-41-25  
Telex: 160124F  
CH,E,MS,P\*

Hewlett-Packard GmbH  
Geschäftsstelle  
Herrenberger Strasse 110  
0-7030 BOBLINGEN  
Tel: (7031) 667-750  
Telex: bbn or  
A,CH,CM,CS,E,MP,P

Hewlett-Packard GmbH  
Geschäftsstelle  
Emanuel-Lutze-Strasse 1  
0-4000 DUSSELDORF  
Tel: (0211) 5971-1  
Telex: 085/86 533 hpdd d  
A,CH,CS,E,MS,P

Hewlett-Packard GmbH  
Vertriebszentrale Frankfurt  
Berner Strasse 117  
Postfach 560 140

0-6000 FRANKFURT 56  
Tel: (0611) 50-04-1

Telex: 04 13249 hpffm d  
A,CH,CM,CS,E,MP,P

Hewlett-Packard GmbH  
Geschäftsstelle  
Kapstdring 5  
0-2000 HAMBURG 60  
Tel: (040) 63804-1

Telex: 021 63 032 hphh d  
A,CH,CS,E,MS,P

Hewlett-Packard GmbH  
Geschäftsstelle  
Heidering 37-39

0-3000 HANNOVER 91

Tel: (0511) 5706-0

Telex: 092 3259

A,CH,CM,E,MS,P

Hewlett-Packard GmbH  
Geschäftsstelle  
Rossauer Weg 2-4

0-6800 MANNHEIM

Tel: (0621) 70050

Telex: 0462105

A,C,E

Hewlett-Packard GmbH  
Geschäftsstelle  
Messerschmittstrasse 7

0-7910 NEU ULM

Tel: 0731-70241

Telex: 07 12816 HP ULM-0

A,C,E\*

Hewlett-Packard GmbH  
Geschäftsstelle  
Neumeyersstrasse 90

0-8500 NUERNBERG

Tel: (0911) 52 20 83-87

Telex: 0623 860

A,CH,CM,E,MS,P

Hewlett-Packard GmbH  
Geschäftsstelle  
Eschenstrasse 5

0-8028 TAUFKIRCHEN

Tel: (089) 6117-1

Telex: 0524985

A,CH,CM,E,MS,P

Hewlett-Packard France  
PLAISIO S.A.

8 Omirou Street

ATHENS 133

Tel: 32 30 303, 32 37 371

Telex: 215962 RKAR GR

A,CH,CM,CS,E,M,P

PLAISIO S.A.

G. Gerards

24 Stourmara Street

ATHENS

Tel: 36-11-160

Telex: 221871

P

## GUATEMALA

IPESA  
Avenida Reforma 3-4B, Zona 9  
GUATEMALA CITY  
Tel: 316627, 314786  
Telex: 4192 TEL TRO GU  
A,CH,CM,CS,E,M,P

## HONG KONG

Hewlett-Packard Hong Kong, Ltd.  
G.P.O. Box 795  
5th Floor, Sun Hung Kai Centre  
30 Harbour Road  
HONG KONG  
Tel: 5-8323211  
Telex: 66678 HEWPA HX  
Cable: HEWPACK HONG KONG  
E,CH,CS,P

## CET Ltd.

1402 Tung Way Mansion  
199-203 Hennessy Rd.  
Wanchia, HONG KONG  
Tel: 5-729376

Telex: B5148 CET HX  
CM

Schmidt & Co. (Hong Kong) Ltd.

Wing On Centre, 2Bth Floor  
Connaught Road, C.

HONG KONG  
Tel: 5-455644

Telex: 74766 SCHMX HX  
A,M

## ICELAND

Elding Trading Company Inc.  
Hafrarnvöli-Tryggvagötu  
P.O. Box B95

IS-REYKJAVIK

Tel: 1-5B-20, 1-63-03  
M

## INDIA

Computer products are sold through  
Blue Star Ltd. All computer repairs  
and maintenance service is done  
through Computer Maintenance  
Corp.

Blue Star Ltd.

Sabri Complex II Floor

24 Residency Rd.

BANGALORE 560 025

Tel: 55660

Telex: 0845-430

Cable: BLUESTAR

A,CH\*,CM,CS\*,E

Blue Star Ltd.

Band Box House

Prabhadevi

BOMBAY 400 025

Tel: 422-3101

Telex: 011-3751

Cable: BLUESTAR

A,M

Blue Star Ltd.

Sahas

414/2 Vir Savarkar Marg

Prabhadevi

BOMBAY 400 025

Tel: 422-6155

Telex: 011-4093

Cable: FROSTBLUE

A,CH\*,CM,CS\*,E,M

Blue Star Ltd.

Kalyan, 19 Vishwas Colony

Alkapuri, BORODA, 390 005

Tel: 65235

Cable: BLUE STAR

A

Blue Star Ltd.

7 Hare Street

CALCUTTA 700 001

Tel: 12-01-31

Telex: 021-7655

Cable: BLUESTAR

A,M

## IRAQ

Blue Star Ltd.  
133 Kodambakkam High Road  
MADRAS 600 034  
Tel: B2057  
Telex: 041-379  
Cable: BLUESTAR  
A,M

## Blue Star Ltd.

Bhandari House, 7th/Bth Floors  
91 Nehru Place  
NEW DELHI 110 024

Tel: 6B2547  
Telex: 031-2463  
Cable: BLUE STAR  
A

## Blue Star Ltd.

2-2-47/110B Bolarum Rd.  
SECUNDERABAD 500 003

Tel: 72057  
Telex: 0155-459  
Cable: BLUEFROST  
A,E

## Blue Star Ltd.

T.C. 7/603 Poornima  
Maruthankuzhi  
TRIVANDRUM 695 013

Tel: 65799  
Telex: 0BB4-259  
Cable: BLUESTAR  
E

## Computer Maintenance Corporation Ltd.

115, Sarojini Devi Road  
SECUNDERABAD 500 003

Tel: 310-1B4, 345-774  
Telex: 031-2960  
CH\*\*

## INDONESIA

BERCA Indonesia P.T.  
P.O.Box 496/JKT.  
Jl. Abdul Muis 62

## JAKARTA

Tel: 373009  
Telex: 46748 BERSAL IA  
Cable: BERSAL JAKARTA  
P

## BERCA Indonesia P.T.

P.O.Box 2497/Jkt Antara Bldg.,  
17th Floor

Jl. Medan Merdeka Selatan 17

## JAKARTA-PUSAT

Tel: 21-344-181

Telex: BERSAL IA

A,CS,E,M

## BERCA Indonesia P.T.

P.O. Box 174/SBY.

Jl. Kutei No. 11

## SURABAYA

Tel: 6B172

Telex: 31146 BERSAL SB

Cable: BERSAL-SURABAYA

A\*,E,M,P

## IRAQ

Hewlett-Packard Trading S.A.

Service Operation

Al Mansoor City 9B/3/7

## BAGHDAD

Tel: 551-49-73

Telex: 212-455 HEPAIRAQ IK

CH,CS

# SALES & SUPPORT OFFICES

Arranged alphabetically by country

3



## IRELAND

Hewlett-Packard Ireland Ltd.  
82/83 Lower Leeson Street  
DUBLIN 2  
Tel: (1) 60 88 00  
Telex: 30439  
A,CH,CM,CS,E,M,P

*Cardiac Services Ltd.*  
*Kilmora Road*  
*Arlane*  
**DUBLIN 5**  
Tel: (01) 351820  
Telex: 30439  
M

## ISRAEL

*Eldan Electronic Instrument Ltd.*  
P.O.Box 1270  
**JERUSALEM 91000**  
16, Ohaliv St.  
**JERUSALEM 94467**  
Tel: 533 221, 553 242  
Telex: 25231 AB/PAKRD IL  
A  
*Electronics Engineering Division*  
*Motorola Israel Ltd.*  
16 Kremenetski Street  
P.O. Box 25016  
**TEL-AVIV 67899**  
Tel: 3-338973  
Telex: 33569 Motil IL  
Cable: BASTEL Tel-Aviv  
CH,CM,CS,E,M,P

## ITALY

Hewlett-Packard Italiana S.p.A  
Traversa 99C  
Via Giulio Petroni, 19  
I-70124 BARI  
Tel: (080) 41-07-44  
M  
Hewlett-Packard Italiana S.p.A.  
Via Martin Luther King, 38/111  
I-40132 BOLOGNA  
Tel: (051) 402394  
Telex: 511630  
CH,E,MS  
Hewlett-Packard Italiana S.p.A.  
Via Principa Nicola 43/G/C  
I-95128 CATANIA  
Tel: (095) 37-10-87  
Telex: 970291  
C,P

Hewlett-Packard Italiana S.p.A.  
Via G. Oi Vittorio 9  
I-20063 CERNUSCO SUL NAVIGLIO  
Tel: (2) 903691  
Telex: 334632  
A,CH,CM,CS,E,MP,P  
Hewlett-Packard Italiana S.p.A.  
Via Nuova San Rocco a  
Capodimonte, 62/A  
I-80131 NAPLES  
Tel: (081) 7413544  
Telex: 710698  
A,CH,E

Hewlett-Packard Italiana S.p.A.  
Viale G. Modugno 33  
I-18156 GENOVA PEGLI  
Tel: (010) 68-37-07  
Telex: 215238  
E,C

Hewlett-Packard Italiana S.p.A.  
Via Turrazza 14  
I-35100 PADOVA  
Tel: (049) 664888  
Telex: 430315  
A,CH,E,MS  
Hewlett-Packard Italiana S.p.A.  
Viale C. Pavese 340  
I-00144 ROMA  
Tel: (06) 54831  
Telex: 610514  
A,CH,CM,CS,E,MS,P\*

Hewlett-Packard Italiana S.p.A.  
Corso Svizzera, 184  
I-10149 TORINO  
Tel: (011) 74 4044  
Telex: 221079  
CH,E

**JAPAN**  
Yokogawa-Hewlett-Packard Ltd.  
152-1, Onna  
000 ATSUGI, Kanagawa, 243  
Tel: (0482) 28-0451  
CM,C\*,E

Yokogawa-Hewlett-Packard Ltd.  
Towa Building  
2-3, Kaigan-dori, 2 Chome Chuo-ku  
KOBE, 650  
Tel: (078) 392-4791  
C,E

Yokogawa-Hewlett-Packard Ltd.  
Kumagaya Asahi 82 Bldg  
3-4 Tsukuba  
KUMAGAYA, Saitama 360  
Tel: (0485) 24-6563  
CH,CM,E

Yokogawa-Hewlett-Packard Ltd.  
Asahi Shinbun Daichi Seimei Bldg.  
4-7, Hanabata-cho  
KUMAMOTO, 860  
Tel: (0963) 54-7311  
CH,E

Yokogawa-Hewlett-Packard Ltd.  
Shin-Kyoto Center Bldg.  
614, Higashi-Shiokoji-cho  
Karasuma-Nishiru  
Shiokoji-dori, Shimogyo-ku  
KYOTO, 600  
Tel: 075-343-0921  
CH,E

Yokogawa-Hewlett-Packard Ltd.  
Mito Mitsui Bldg  
4-73, Sannomaru, 1 Chome  
MITO, Ibaragi 310  
Tel: (0292) 25-7470  
CH,CM,E

Yokogawa-Hewlett-Packard Ltd.  
Sumitomo Seimei 14-9 Bldg.  
Meieki-Minami, 2 Chome  
Nakamura-ku

NAGOYA, 450  
Tel: (052) 57-15171  
CH,CM,CS,E,MS

Yokogawa-Hewlett-Packard Ltd.  
Chu Bldg.,  
4-20 Nishinakajima, 5 Chome  
Yodogawa-ku

OSAKA, 532  
Tel: (06) 304-6021  
Telex: YHPOSA 523-3624  
A,CH,CM,CS,E,MP,P\*

Yokogawa-Hewlett-Packard Ltd.  
27-15, Yabe, 1 Chome  
SAGAMIHARA Kanagawa, 229  
Tel: 0427 59-1311

Yokogawa-Hewlett-Packard Ltd.  
Oaiichi Seimei Bldg.  
7-1, Nishi Shinjuku, 2 Chome  
Shinjuku-ku, TOKYO 160  
Tel: 03-348-4611-5  
CH,E

Yokogawa-Hewlett-Packard Ltd.  
29-21 Takaido-Higashi, 3 Chome  
Suginami-ku TOKYO 168  
Tel: (03) 331-6111  
Telex: 232-2024 YHPTOK  
A,CH,CM,CS,E,MP,P\*

Yokogawa-Hewlett-Packard Ltd.  
Oaiichi Asano Building  
2-8, Odori, 5 Chome  
UTSUNOMIYA, Tochigi 320  
Tel: (0286) 25-7155  
CH,CS,E

Yokogawa-Hewlett-Packard Ltd.  
Yasuda Seimei Nishiguchi Bldg.  
30-4 Tsurya-cho, 3 Chome  
YOKOHAMA221  
Tel: (045) 312-1252  
CH,CM,E

**JORDAN**  
*Mousher Cousins Company*  
P.O. Box 1387  
**AMMAN**  
Tel: 24907, 39907  
Telex: 21456 SABCO JO  
CH,E,M,P

**KENYA**  
ADCOM Ltd., Inc., Kenya  
P.O.Box 30070  
**NAIROBI**  
Tel: 331955  
Telex: 22639  
E,M

**KOREA**  
Samsung Electronics Computer  
Division  
76-561 Yeoksam-Dong  
Kwangnam-Ku  
C.P.O. Box 2775  
**SEOUL**  
Tel: 555-7555, 555-5447  
Telex: K27364 SAMSAN  
A,CH,CM,CS,E,M,P

**KUWAIT**  
Al-Khalidiya Trading & Contracting  
P.O. Box 830 Safat  
**KUWAIT**  
Tel: 42-4910, 41-1726  
Telex: 22481 Areeg kt  
CH,E,M

Photo & Cine Equipment  
P.O. Box 270 Safat  
**KUWAIT**  
Tel: 42-2846, 42-3801  
Telex: 22247 Malin kt  
P

**LEBANON**  
G.M. Dolmadian  
Achrafieh  
P.O. Box 165.167  
**BEIRUT**  
Tel: 290293  
MP\*\*

**LUXEMBOURG**  
Hewlett-Packard Belgium S.A./N.V.  
Blvd de la Wolwe, 100  
Woluwe  
B-1200 BRUSSELS  
Tel: (02) 762-32-00  
Telex: 23-494 paloben bru  
A,CH,CM,CS,E,MP,P

**MALAYSIA**  
Hewlett-Packard Sales (Malaysia)  
Sdn. Bhd.  
1st Floor, Bangunan British  
American

Jalan Semantan, Oamansara Heights  
KUALA LUMPUR 23-03  
Tel: 943022  
Telex: MA31011  
A,CH,E,MP,P\*

Protei Engineering  
P.O.Box 1917  
Lot 6624, Section 64  
23/4 Pending Road  
Kuching, SARAWAK  
Tel: 36299  
Telex: MA 70904 PROTEL  
A,CH,E,M,P

**MALTA**  
Philip Toledo Ltd.  
Notabile Rd.  
**MRIEHEL**  
Tel: 447 47, 455 66  
Telex: Media MW 649  
P

**MEXICO**  
Hewlett-Packard Mexicana, S.A.  
de C.V.  
Av. Periferico Sur No. 6501  
Tepepan, Xochimilco  
**MEXICO D.F. 16020**  
Tel: 676-4600  
Telex: 17-74-507 HEWPACK MEX  
A,CH,CS,E,MS,P

Hewlett-Packard Mexicana, S.A.  
de C.V.  
Ave. Colonia del Valle #409  
Col. del Valle  
Municipio de Garza Garcia  
**MONTERREY, N.L.**  
Tel: 78 42 41  
Telex: 038 410  
CH

**ECISA**  
José Vasconcelos No. 218  
Col. Condesa Deleg. Cuauhtémoc  
**MEXICO D.F. 06140**  
Tel: 553-1206  
Telex: 17-72755 ECE ME  
M

**MOROCCO**  
Dolbeau  
81 rue Karatchi  
**CASABLANCA**  
Tel: 3041-82, 3068-38  
Telex: 23051, 22822  
E

Gerep  
2 rue d'Agadir  
Boite Postale 156  
**CASABLANCA**  
Tel: 272093, 272095  
Telex: 23 739  
P

**NETHERLANDS**  
Hewlett-Packard Nederland B.V.  
Van Heuven Goedhartlaan 121  
NL 118 IKK AMSTELVEEN  
P.O. Box 667

NL 1180 AR AMSTELVEEN  
Tel: (020) 47-20-21  
Telex: 13 216 HEPA NL  
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Telex: 21261 HEPAC NL  
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P.O. Box 9443  
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Tel: 794-091  
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P.O. Box 8388  
**CHRISTCHURCH**  
Tel: 486-928  
Telex: 4203  
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Sturdee House  
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**WELLINGTON**  
Tel: 850-091  
Telex: NZ 3380  
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See United Kingdom

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Folke Bernadottes vei 50  
P.O. Box 3558  
N-5033 FYLLINGSDALEN (Bergen)

Tel: (05) 16-55-40  
Telex: 16621 hpnas n  
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Hewlett-Packard Norge A/S  
Österndalen 18  
P.O. Box 34  
N-1345 ÖSTERÅS  
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Quadrangle

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## NORTH/CENTRAL AFRICA

Hewlett-Packard S.A.  
7 Rue du Bois-du-Lan  
CH-1217 MEYRIN 1, Switzerland  
Tel: (022) 83 12 12  
Telex: 27835 hpse  
Cable: HEWPACKSA Geneve

## ASIA

Hewlett-Packard Asia Ltd.  
6th Floor, Sun Hung Kai Centre  
30 Harbour Rd.  
G.P.O. Box 795  
HONG KONG  
Tel: 5-832 3211  
Telex: 66678 HEWPA HX  
Cable: HEWPACK HONG KONG

## CANADA

Hewlett-Packard (Canada) Ltd.  
6877 Goreway Drivve  
MISSISSAUGA, Ontario L4V 1M8  
Tel: (416) 678-9430  
Telex: 610-492-4246

## EASTERN EUROPE

Hewlett-Packard Ges.m.b.h.  
Liebigasse 1  
P.O.ox 72  
A-1222 VIENNA, Austria  
Tel: (222) 2365110  
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## NORTHERN EUROPE

Hewlett-Packard S.A.  
Uilenstede 475  
NL-1183 AG AMSTELVEEN  
The Netherlands  
P.O.ox 999  
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Tel: 20 437771

## OTHER EUROPE

Hewlett-Packard S.A.  
7 rue du Bois-du-Lan  
CH-1217 MEYRIN 1, Switzerland  
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## MEDITERRANEAN AND MIDDLE EAST

Hewlett-Packard S.A.  
Mediterranean and Middle East  
Operations  
Alrina Centre  
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## EASTERN USA

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## WESTERN USA

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3939 Lankershim Blvd.  
LOS ANGELES, CA 91604  
Tel: (213) 877-1282

## OTHER INTERNATIONAL AREAS

Hewlett-Packard Co.  
Intercontinental Headquarters  
3495 Deer Creek Road  
PALO ALTO, CA 94304  
Tel: (415) 857-1501  
Tele: 034-8300  
Cable: HEWPACK

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